

Soil Survey of

BENSON COUNTY

AREA,

NORTH DAKOTA

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE AND

UNITED STATES DEPARTMENT OF INTERIOR

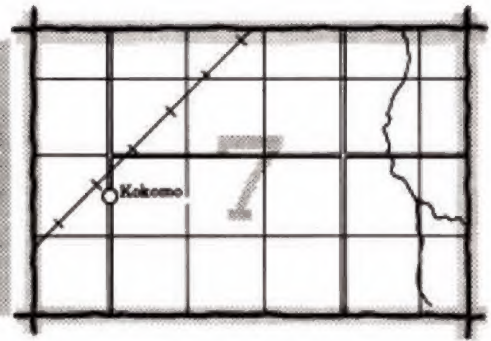
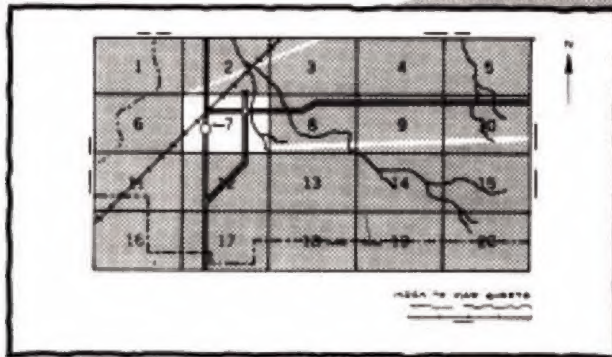
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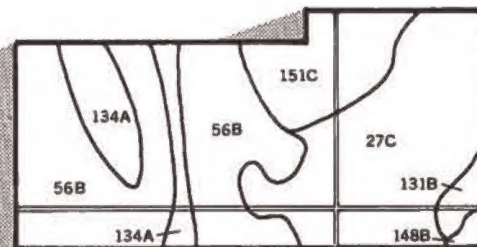
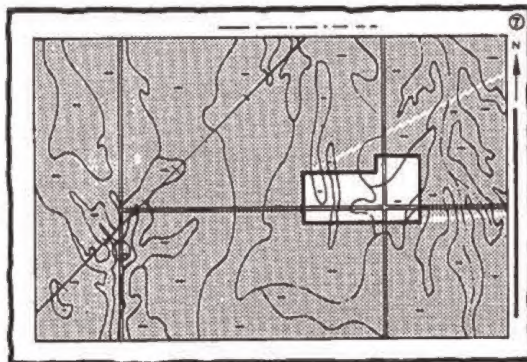
HOW TO USE

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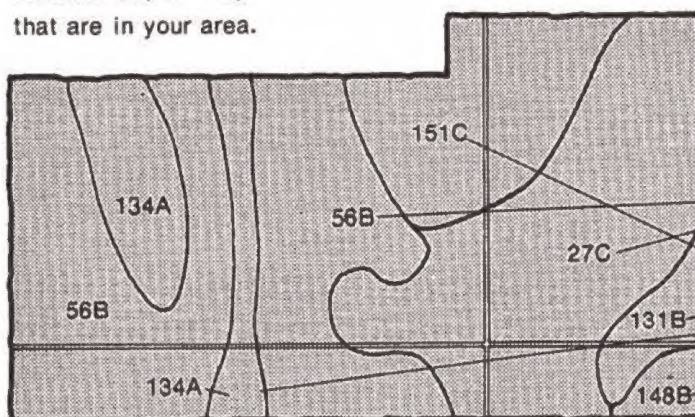


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



4. List the map unit symbols that are in your area.



Symbols

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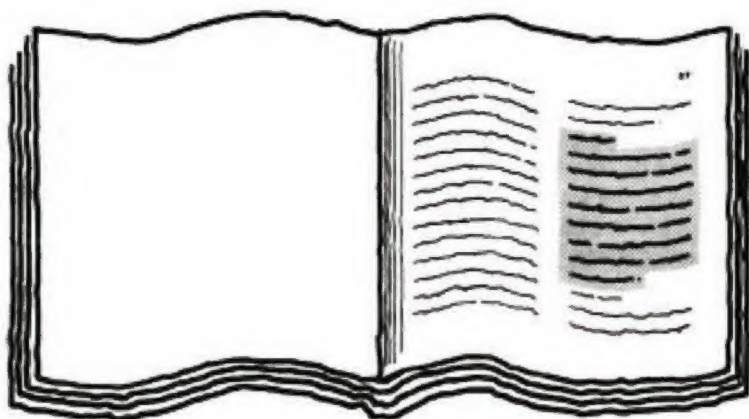
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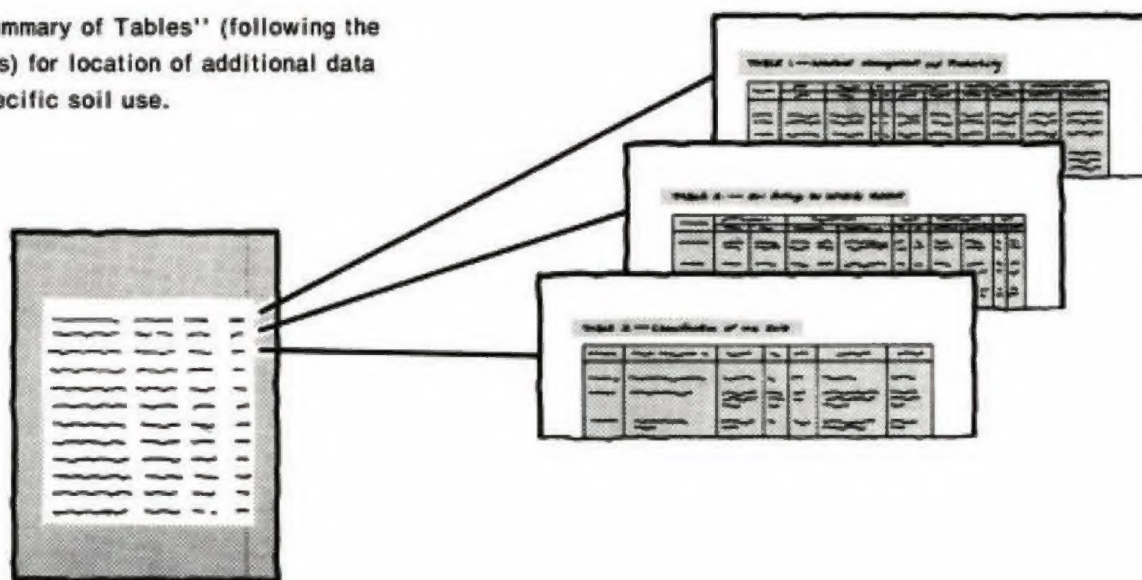
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THIS SOIL SURVEY

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- 6.** See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



- 7.** Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1969 to 1977. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service, the Bureau of Indian Affairs, and the North Dakota Agricultural Experiment Station. It is part of the technical assistance furnished to the North Central Soil Conservation District. Financial assistance was provided by the Benson County Board of Commissioners.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

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Foreword

This soil survey contains information that can be used in land-planning programs in Benson County Area, North Dakota. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

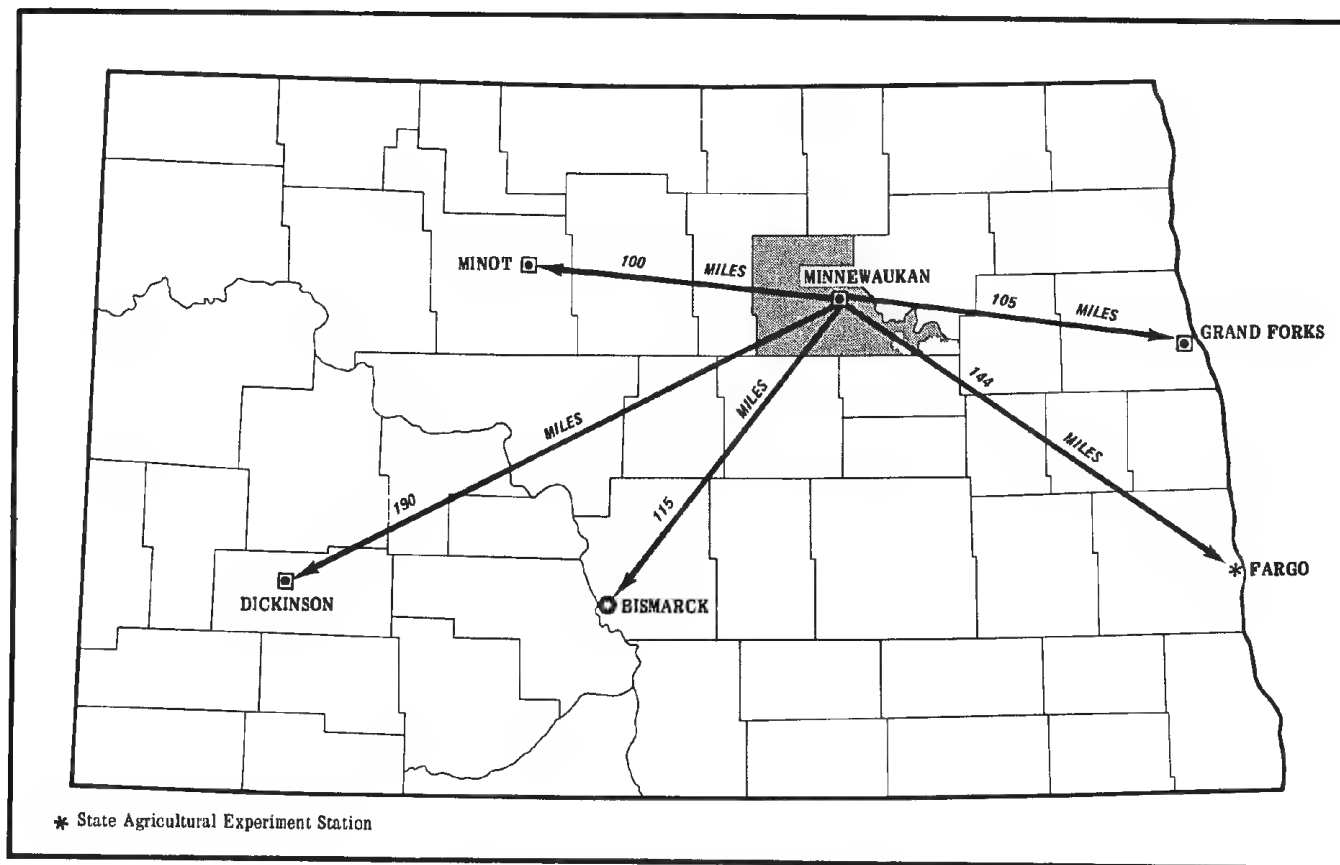
This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.



Allen L. Fisk
State Conservationist
Soil Conservation Service



Location of Benson County Area in North Dakota.

SOIL SURVEY OF BENSON COUNTY AREA, NORTH DAKOTA

By James F. Strum, Cornelius J. Heidt, and Ricky J. Bigler, Soil Conservation Service

Field work by James F. Strum, Robert H. Dahl, Kenneth W. Thompson, Stuart J. Larson, Robert Hetzler, M. Robert Wright, Donald D. Opdahl, Terry R. Peterson, Cornelius J. Heidt, and Ricky J. Bigler of the Soil Conservation Service, and Kenneth Bajema and Jack Workenton of the Bureau of Indian Affairs

United States Department of Agriculture Soil Conservation Service and
United States Department of Interior, Bureau of Indian Affairs, in cooperation with
the North Dakota Agricultural Experiment Station

Benson County Area is in the north-central part of North Dakota. Minnewaukan, the county seat, has a population of 496. The survey area has a total area of 867,644 acres or 1,356 square miles.

The survey area is in the Central Lowland Province and is along the eastern edge of the Williston Basin. It is in the physiographic unit known as the drift prairie and in the drainage basin of the Red River of the North. The surface water which does not flow into the Hudson Bay by way of the Sheyenne River and Red River of the North flows into the closed basin of the Devils Lake chain.

Most of the soils in the survey area formed in glacial till, glacial outwash, or glacial lake sediment. The major part of the area is gently rolling glacial till plains. The sandy and gravelly outwash sediment is associated with Martin, Heimdal, McHenry, and North Viking end moraines. These end moraines are mainly undulating to hilly glacial till. The sediment associated with glacial Devils Lake in the eastern part of the survey area is nearly level clayey lacustrine and sandy beach material. The sediment associated with glacial Lake Souris in the north-western corner of the survey area is sandy. Some recent alluvial sediment is in the Sheyenne River Valley and glacial outwash channels.

General nature of the county

This part of the publication provides general information on the settlement, climate, natural resources, and farming of Benson County Area.

Settlement

Prior to any permanent settlement in Benson County, Sioux Indians inhabited the area around Devils Lake. Their livelihood depended mostly on hunting, fishing, and the abundance of wild fruit and berries. In the late 1700's and early 1800's fur traders occasionally ventured into the area. Shortly after the War of 1812, Captain Duncan Graham, (5) a fur trader, made temporary residence in a wooded area of the west side of Devils Lake. The area, a remnant of an island when the lake was much larger, was later named Grahams Island in his honor. Captain Graham lived on the island a few years then went back to his home in Prairie du Chien, Wisconsin.

The fur trade began to decline in the mid-1800's after the smallpox epidemic greatly reduced the Indian population. Red River Metis and gold seekers crossing the plains greatly reduced the amount of game. The fur trade came to a close after the wars in the 1860's and the confinement of the Indians to reservation life (7).

In 1867, General A.H. Terry established Ft. Totten on the reservation on the south shore of Devils Lake (6). Ft. Totten was one of a series of outposts for the protection of an overland route from southern Minnesota to western Montana. Many Sioux Indians gathered on the reservation, and in 1874 the Gray Nuns of Montreal started a school and mission for them. The fort was largely self-sufficient at that time, because the railroad had not yet reached that far west.

Ft. Totten was a convenient base for early settlers in the area. The first permanent settlement in Benson County was at Grahams Island. The early settlers, mostly of Scottish and Irish descent, favored this wooded area

because it was similar to their former homes in the east. By 1883, Grahams Island was permanently settled.

With the coming of the railroad in the 1880's and early 1890's, migrants from Minnesota, Wisconsin, and Iowa, as well as immigrants from northern Europe, came by the hundreds. Land was obtained from the railroad and from the government through the Homestead and Timber Culture Act. This settlement began around Minnewaukan and Oberon and by 1898 spread to the western part of the county around Esmond. By the early 1900's, the county was nearly permanently settled.

Benson County was organized on June 4, 1894. The name is derived from B. W. Benson, who, in 1884, was a member of the Dakota Territory legislature from Barnes County. Minnewaukan was established as the county seat.

The 1970 population figures for the four largest towns in Benson County were 708 for Maddock, 626 for Leeds, 496 for Minnewaukan, and 416 for Esmond. The population of Benson County in 1900 was 8,220 and in 1920 was 13,095. Population decreased in the late 1920's and 1930's because of depression and drought. By 1970, the population was 8,245 (4).

Climate

Data in this section were prepared by the National Climatic Center, Asheville, North Carolina.

In summer, Benson County has frequent spells of hot weather and occasional cool days. It is very cold in winter, when Arctic air frequently surges over the county. Most precipitation falls during the warm period and is heaviest late in spring and early in summer. Winter snowfall is normally not too heavy and is blown into drifts so that much of the ground is free of snow.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Leeds, North Dakota, for the period 1951 to 1974. Table 2 shows probable dates for the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 8 degrees F, and the average daily minimum is -2 degrees F. The lowest temperature, -41 degrees F., was recorded at Leeds on January 26, 1954. In summer, the average temperature is 66 degrees F., and the average daily maximum is 80 degrees F. The highest temperature, 104 degrees F., was recorded on July 28, 1959.

Growing degree days, shown in table 1, are equivalent to "heat units." Beginning in spring, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature of 40 degrees F. The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 13 inches, or 72 percent, usually falls during the period from April through September, which includes the growing season for most crops. Two years in 10, the April to September rainfall is less than 11 inches. The heaviest 1-day rainfall during the period of record was 2.82 inches at Leeds on April 24, 1953. About 25 thunderstorms occur each year, 20 of which are in summer.

The average seasonal snowfall is 37 inches. The greatest snow depth at any one time during the period of record was 33 inches. On the average, at least 1 inch of snow is on the ground for 44 days of the year, but the number of days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent, at dawn it is about 81 percent, and at night in all seasons it is higher. The percentage of possible sunshine is 70 percent in summer and 50 percent in winter. The prevailing wind direction is from the southwest. In April, the average windspeed is highest at 12 miles per hour.

Several times each winter storms of snow and high wind bring blizzards to the county. During summer thunderstorms, hail occurs in small, scattered areas.

Natural resources

Soil is the most important natural resource in the survey area. The crops produced and the livestock that graze the grassland are marketable products derived from the soil.

There is no lignite coal or salt in commercial quantities in the Benson County Area. Some wells have been drilled, but none at this time have produced commercial oil or gas.

As a result of glaciation, there are areas of sandy and gravelly materials favorable for commercial excavation. These materials are associated with ice-contact, outwash, and terrace deposits. Troublesome points are related to poor sorting and high shale content. The quality of the deposits is variable, and investigation of each deposit helps determine its usefulness for a specific purpose (3).

Areas of water more than 40 acres in size make up about 2 percent of the survey area. Some of the surface water, particularly in the northwestern part, is saline and is not used by livestock. Several large underground aquifers are in the survey area, one in the southwestern part; another extends south from east of Leeds along the eastern part of the county and along the southern edge of Devils Lake. Another aquifer is in the southeastern part of the area (3). Most of the ground water-bearing material is sand, gravel, gravelly sand, shaly gravel, and shale. These aquifers are important to the development of irrigation, provided the water is of suitable quality.

Farming

The first settlers who farmed the survey area settled around Minnewauken and Oberon. From here the settlement spread rapidly to the western part of the county. The Soil Conservation District, which included parts of southern Towner County, was established in 1940.

The main crop in the survey area is wheat. Flax, barley, oats, and alfalfa are other main crops. Flax is grown for linseed oil, and straw is an important by-product. Barley is grown for both feed and malting. Oats and alfalfa are important feed crops. Sunflowers, are becoming an increasingly important cash crop.

In 1970, there were about 935 farms. About 74 percent of the area, or 646,000 acres, is cropland; 17 percent, or 146,000 acres, is rangeland and pasture; and the remaining 9 percent, or 75,000 acres, is woodland, federal non-cropland, and other land.

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management

are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

General soil map for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

As a result of changes in soil series concepts, differing soil patterns, and map unit design, some of the boundaries and soil series names on the Benson County Area general soil map do not match those on the general soil maps of Pierce, Wells, and Eddy Counties.

Soils formed mainly in glacial till on uplands

The soils of these seven map units are mainly on nearly level to hilly ground moraines, but some are on very steep end moraines. The soils formed under grassland or forest vegetation (fig. 1). These map units make up about 81 percent of the survey area.

1. Emrick-Heimdal-Fram

Deep, nearly level and gently sloping, well drained to somewhat poorly drained, medium textured soils formed in loam and sandy clay loam glacial till

These soils are on glacial till plains consisting of smooth ground moraines. The areas have several shallow depressions.

This map unit makes up about 12 percent of the survey area. It is about 32 percent Emrick soil, 21 per-



Figure 1.—Barnes and Svea soils (foreground) formed under grassland in glacial till; Bottineau and Aastad soils (background) formed under forest vegetation in glacial till.

cent Heimdal soil, 12 percent Fram soil, and 35 percent water or soils of minor extent.

The gently sloping, well drained Heimdal soils are on higher elevations. The nearly level, moderately well drained Emrick soils are on intermediate areas, in swales, and on lower elevations. The nearly level, somewhat poorly drained Fram soils are on lower elevations, on rims of depressions, and on slight rises within areas of the Emrick soils (fig. 2).

The minor soils in this map unit are the Cathay, Esmond, Larson, Parnell, and Tonka soils. The well

drained Esmond soils are on knobs and ridges. The poorly drained Tonka soils and very poorly drained Parnell soils are in depressions. The moderately well drained Cathay and Larson soils are sodic soils in slight depressions in nearly level areas. Parnell ponded soils and some areas of water are also in this unit.

Most of the soils in this unit are used for cropland. The Tonka, Parnell, Cathay, Larson, and Parnell ponded soils are used for pasture and hay production or wetland wildlife habitat. The minor Esmond soils having lesser slopes are used for cropland, and those on steeper areas are

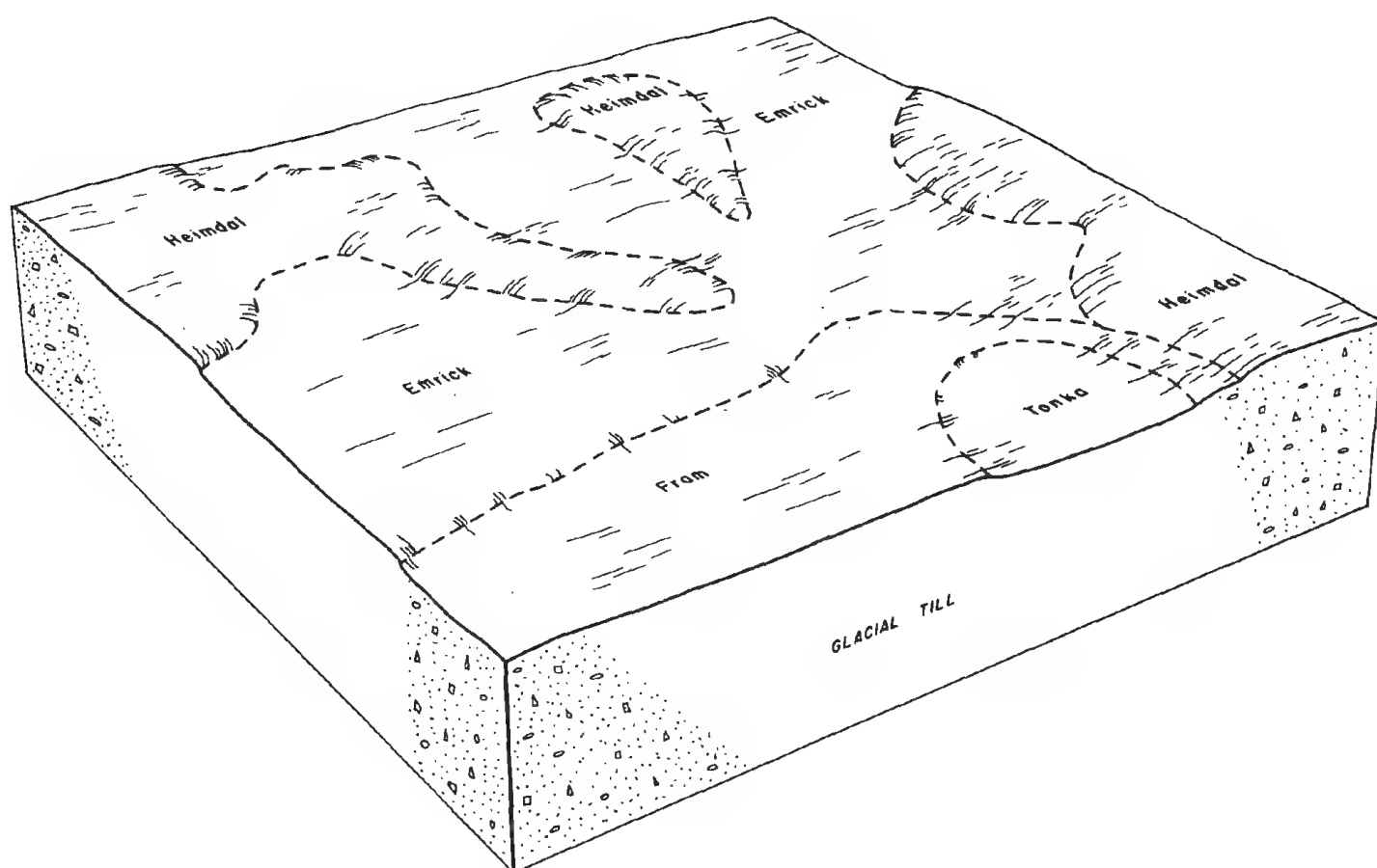


Figure 2.—Parent material and position of soils in the Emrick-Heimdal-Fram map unit.

used for pasture and hayland.

The main limitations for use of the major soils for farming are the hazards of water erosion and soil blowing. The main limitations for most other uses are the seasonal high water table and wetness of the Fram soils and the moderate permeability of all the major soils.

These soils have good potential for cultivated crops, range, and windbreaks. The Emrick and Heimdal soils have good potential for recreational uses and most residential and urban uses and have poor potential for wetland wildlife habitat. The Fram soils have poor potential for wetland wildlife habitat and fair potential for recreational uses and most urban and residential uses. Potential for wetland wildlife habitat is good on the Parnell, ponded, Parnell, and Tonka soils.

2. Heimdal-Emrick-Esmond

Deep, nearly level to very steep, well drained and moderately well drained, medium textured soils formed in loam and sandy clay loam glacial till

These soils are on glacial till plains consisting of

ground moraines and coulee breaks. These areas have some depressions. In places, there are stones on knolls and ridges.

This map unit makes up about 18 percent of the survey area. It is about 30 percent Heimdal soils, 22 percent Emrick soils, 13 percent Esmond soils, and 35 percent water or soils of minor extent.

The nearly level to very steep, well drained Heimdal soils are on intermediate areas on side slopes. The nearly level and moderately sloping, moderately well drained Emrick soils are in swales and are lower on side slopes. The gently rolling to very steep, well drained Esmond soils are on higher elevations of hilltops, knolls, and ridges.

The minor soils in this map unit are the Cathay, Fram, Larson, Parnell, Tonka, and Vallery soils. The moderately well drained Cathay soils and the moderately well drained and somewhat poorly drained Larson soils are sodic soils in slight depressions in nearly level areas. The poorly drained Tonka soils and very poorly drained Parnell soils are in depressions. The somewhat poorly drained Fram soils are on rims of depressions and on

slight rises within areas of the Emrick soils. The poorly drained Vallers soils are on rims of depressions and in low lying areas between depressions. Also in the unit are the Parnell ponded soils and some areas of water.

Most of the soils in this unit are used for cropland, as are the Cathay and Fram soils. The Tonka, Parnell, Larson, Vallers, and Parnell ponded soils are used for pasture and hay production or wetland wildlife habitat. Esmond soils are on higher side slopes and are used for pasture and hay.

The main limitations for use of the major soils for farming are the hazards of water erosion and soil blowing. The main limitation for most other uses is the moderate permeability of all the major soils.

These soils have good potential for range, windbreaks, most residential and urban uses, and recreational uses. The Heimdal and Emrick soils have good potential for cultivated crops and poor potential for wetland wildlife habitat. The Esmond soils have fair potential for cultivated crops and poor potential for wetland wildlife habitat. Potential for wetland wildlife habitat is good on the Parnell ponded, Parnell, and Tonka soils.

3. Emrick-Cathay-Larson

Deep, nearly level and gently sloping, moderately well drained and somewhat poorly drained, medium textured soils formed in loam and clay loam glacial till

These soils are on glacial till plains consisting of slight rises and slightly depressed areas of glacial uplands and are in basins, coulee bottoms, and drainageways. In some places there are depressions and slightly higher ground moraine areas.

This map unit makes up about 2 percent of the survey area. It is about 40 percent Emrick soils, 11 percent Cathay soils, 10 percent Larson soils, and 39 percent water or soils of minor extent.

The nearly level and gently sloping, moderately well drained Emrick soils are on slight rises. The nearly level and gently sloping, moderately well drained Cathay soils and the nearly level, moderately well drained and somewhat poorly drained Larson soils are sodic soils and are in slight depressions, basins, coulee bottoms, and drainageways.

The minor soils in this map unit are the Fram, Hamerly, Parnell, Tonka, and Vallers soils. The poorly drained Tonka soils and very poorly drained Parnell soils are in shallow to deep depressions. The somewhat poorly drained Fram and Hamerly soils are on the level and nearly level lower areas on rims of depressions and on slight rises within areas of the Emrick soils. The poorly drained Vallers soils are on rims of depressions and in low lying areas between depressions. The Hamerly and Vallers soils are in small areas underlain by loam and clay loam glacial till.

About half of the soils in this unit are used for cropland, and half are used for pasture, range, and hay. The

Fram and Hamerly soils are used for cropland. The Parnell, Tonka, and Vallers soils are used for pasture and hay production or wetland wildlife habitat.

The main limitations for use of the major soils for farming are the hazard of water erosion and poor soil tilth. The main limitations for most other uses are the moderate permeability of the Emrick soils and the slow permeability of the Cathay and Larson soils.

These soils have fair potential for most residential and urban uses and very poor potential for wetland wildlife habitat. The Emrick soils have good potential for cultivated crops, range, windbreaks, and most recreational uses. The Cathay soils have fair potential for windbreaks and good potential for range, cultivated crops, and for most recreational uses. The Larson soils have poor potential for cultivated crops and windbreaks and fair potential for range and most recreational uses. Potential for wetland wildlife habitat is good on the Parnell, Tonka, and Vallers soils.

4. Svea-Barnes-Hamerly

Deep, nearly level and gently sloping, well drained to somewhat poorly drained, medium textured soils formed in loam and clay loam glacial till

These soils are on glacial till plains consisting of ground moraines with swells and swales. Several shallow depressions are scattered throughout the map unit.

This map unit makes up about 36 percent of the survey area. It is about 30 percent Svea soils, 20 percent Barnes soils, 20 percent Hamerly soils, and 30 percent water or soils of minor extent.

The nearly level and gently sloping, well drained Barnes soils are on higher elevations. The nearly level and gently sloping, moderately well drained Svea soils are on intermediate areas, in swales, and on lower side slopes. The nearly level and gently sloping, somewhat poorly drained Hamerly soils are on lower elevations, on rims of depressions, and on slight rises within areas of the Svea soils (fig. 3).

The minor soils in this map unit are the Buse, Cavour, Cresbard, Parnell, and Tonka soils. The well drained Buse soils are on knobs and ridgetops. The moderately well drained Cresbard and Cavour soils are sodic soils in slight depressions in nearly level areas. The poorly drained Tonka soils and very poorly drained Parnell soils are in depressions. Parnell ponded soils and some areas of water are also in this unit.

Most areas of these soils are used for cropland, as are the Cresbard soils within areas of the Svea soils. The Cavour, Cresbard, Tonka, Parnell, and Parnell ponded soils are used for pasture and hay production or wetland wildlife habitat.

The main limitations for use of the major soils for farming are the hazards of soil blowing and water erosion. The main limitations for most other uses are the seasonal high water table and wetness of the Hamerly soils and the moderately slow permeability of all the major soils.

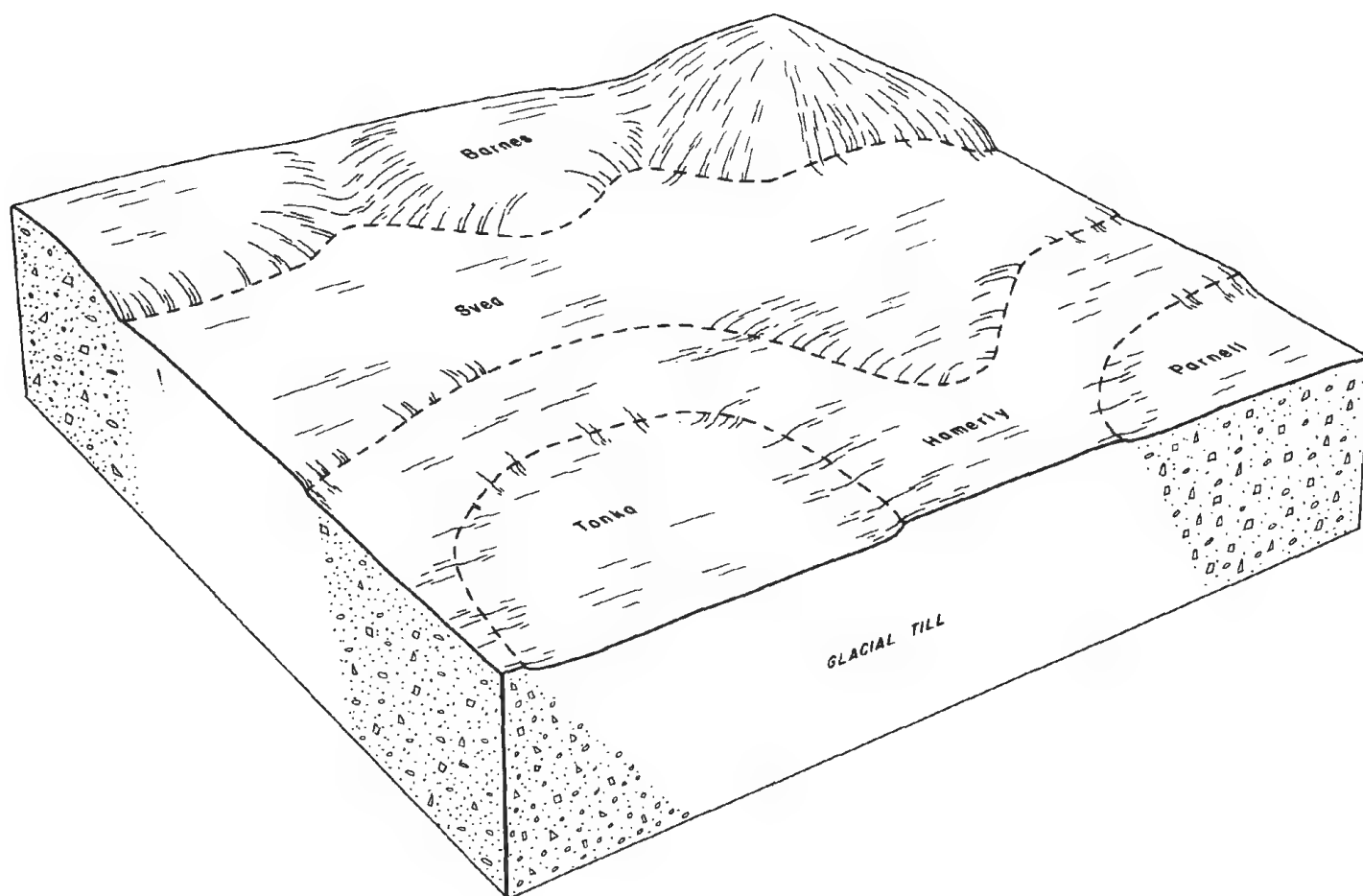


Figure 3.—Parent material and position of soils in the Svea-Barnes-Hamerly map unit.

These soils have good potential for cultivated crops, pasture, range, and windbreaks. The Svea and Barnes soils have good potential for most residential, urban, and recreational uses and poor potential for wetland wildlife habitat. The Hamerly soils have poor potential for wetland wildlife habitat and fair potential for residential, urban, and recreational uses. Potential for wetland wildlife habitat is good on the Parnell ponded, Parnell, and Tonka soils.

5. Barnes-Buse

Deep, undulating to hilly, well drained, medium textured soils formed in loam glacial till

These soils are on glacial till moraines with many knolls, ridges, and deep depressions. In some places, stones are on the knolls and ridges.

This map unit makes up about 9 percent of the survey area. It is about 26 percent Barnes soils, 24 percent Buse soils, and 50 percent water or soils of minor extent.

The undulating and gently rolling, well drained Barnes soils are on the side slopes, and the gently rolling and

hilly, well drained Buse soils are on knolls, ridges, and hilltops (fig. 4).

The minor soils in this map unit are the Hamerly, Parnell, Tonka, and Vallery soils. The very poorly drained Parnell soils and poorly drained Tonka soils are in deep depressions. The somewhat poorly drained Hamerly soils and poorly drained Vallery soils are on rims of depressions and in low lying areas between depressions. Parnell ponded soils and some areas of water are also in this unit.

Most rolling and hilly areas are used for pasture, range, and hay. The undulating and gently rolling areas are used for cropland, as are the Hamerly soils. The Parnell, Tonka, Vallery and Parnell ponded soils are used for pasture and hay production or wetland wildlife habitat.

The main limitations for use of the major soils for farming are the hazards of soil blowing and water erosion. The main limitation for most other areas is the moderately slow permeability of all the major soils.

These soils have very poor potential for wetland wild-

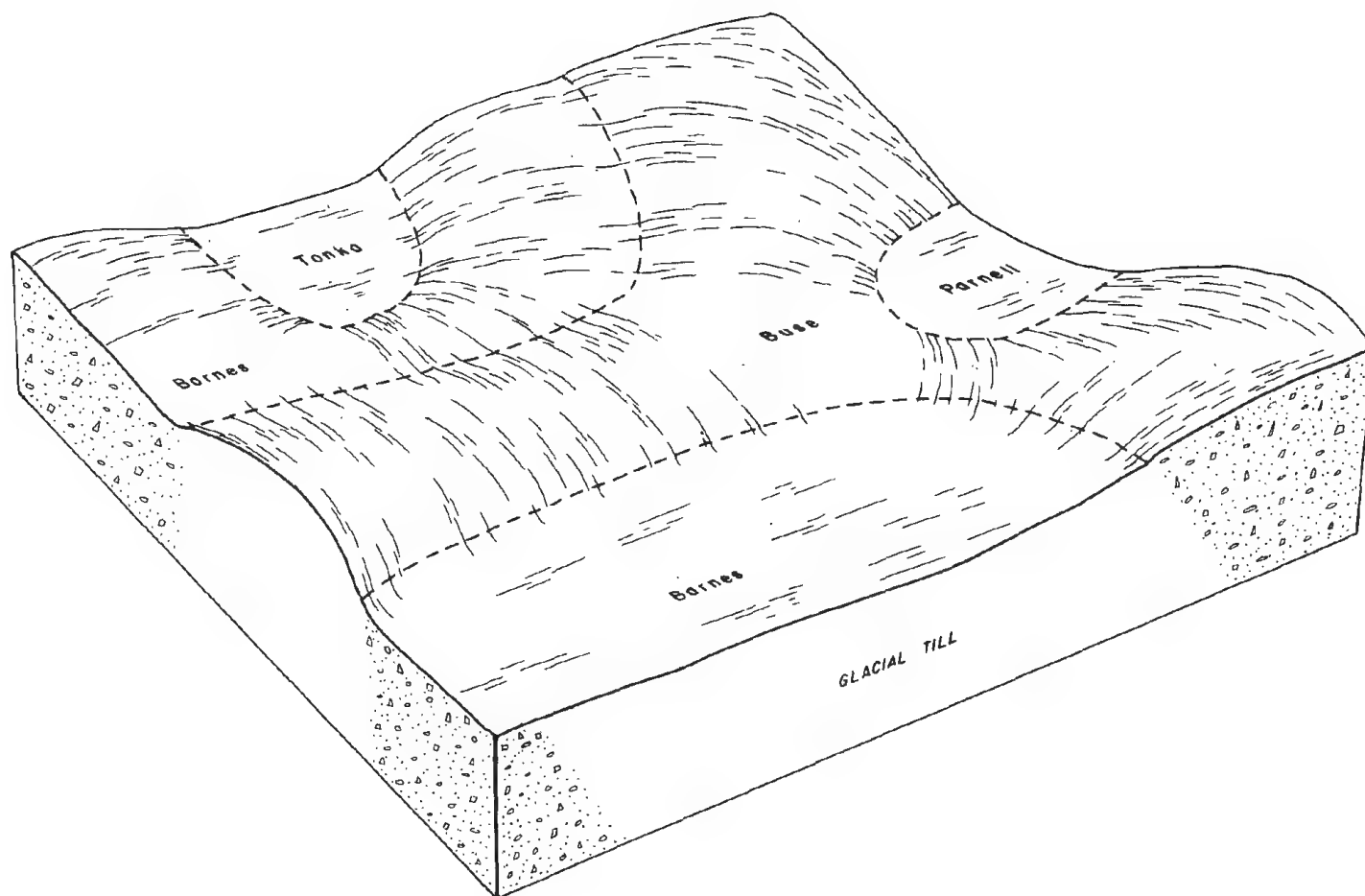


Figure 4.—Parent material and position of soils in the Barnes-Buse map unit.

life habitat. The Barnes soils have good potential for range; fair potential for cultivated crops, windbreaks, and most residential and urban uses; and fair to good potential for most recreational uses. The Buse soils have fair potential for range and poor potential for cultivated crops, windbreaks, most recreational uses, and most residential and urban uses. Potential for wetland wildlife habitat is good on the Parnell ponded, Parnell, Tonka, and Vallers soils.

6. Svea-Grano-Aberdeen

Deep, level to gently sloping, moderately well drained, poorly drained, and very poorly drained, medium textured to fine textured soils formed in loam glacial till and in silty clay loam and clay lacustrine sediment

These soils are on glacial till plains and glacial lake plains and are in slight depressions; on gentle rises; on broad, gentle swells; and in low lying areas between depressions.

This map unit makes up about 2 percent of the survey area. It is about 28 percent Svea soils, 22 percent Grano soils, 13 percent Aberdeen soils, and 37 percent water or soils of minor extent.

The gently sloping, moderately well drained Svea soils are on gentle rises and higher swells. The level, moderately well drained Aberdeen soils are sodic soils on the gentle swells and in shallow depressions. The level, poorly drained and very poorly drained Grano soils are in deeper swales and in broad, low lying areas.

The minor soils in this map unit are the Hamerly, Parnell, and Tonka soils. The somewhat poorly drained

Hamerly soils are on rims of depressions, in low lying areas between depressions, and are slightly below the Svea soils. The poorly drained Tonka soils and very poorly drained Parnell soils are in deep depressions. Parnell ponded soils and some areas of water are also in this unit.

Most areas of these soils are used for cropland as are the Hamerly soils, and some are used for hayland and pasture. The Parnell, Parnell ponded, and Tonka soils are used for pasture and hay production or wetland wildlife habitat.

The main limitations for use of the major soils for farming are the hazard of soil blowing, poor soil tilth, and wetness. The main limitations for most other uses are the seasonal high water table, wetness, and slow permeability of the Grano soils; the slow permeability of the Aberdeen soils; and the moderately slow permeability of the Svea soils.

These soils have good potential for range and poor potential for most residential, urban, and recreational uses. The Svea soils have good potential for cultivated crops, windbreaks, recreational uses, and most residential and urban uses and poor potential for wetland wildlife habitat. The Aberdeen soils have very poor potential for wetland wildlife habitat. The Grano soils have poor potential for cultivated crops and windbreaks and good potential for wetland wildlife habitat. Potential for wetland wildlife habitat is good for the Parnell ponded, Parnell, and Tonka soils.

7. Bottineau-Aastad-Edgeley Variant

Deep, gently sloping to very steep, moderately well drained and well drained, medium textured soils formed in loam and clay loam glacial till

These soils are on glacial till plains and moraines with knolls, ridges, hills, and small shallow swales. The swales contain several deep depressions.

This map unit makes up about 2 percent of the survey area. It is about 50 percent Bottineau soils, 15 percent Aastad soils, 5 percent Edgeley Variant soils, and 30 percent water or soils of minor extent.

The gently sloping and undulating to hilly, well drained Bottineau soils are on the side slopes. The gently sloping and undulating, moderately well drained Aastad soils are in swales and on lower side slopes. The hilly to very steep, well drained Edgeley Variant soils are on the upper side slopes, hilltops, and ridges.

The minor soils in this map unit are the Buse, Parnell, and Tonka soils. The well drained Buse soils are on similar positions to those of the Edgeley Variant soils and are in small areas underlain by loam and clay loam glacial till. The very poorly drained Parnell soils and poorly drained Tonka soils are in deep depressions. Parnell ponded soils and some areas of water are also in this unit.

Most areas of the soils in this unit are used for woodland pasture, but some undulating and gently rolling areas are cleared of trees and used for cropland. The Buse soils are mainly used for pasture. In some undulating and gently rolling areas where unit size permits, these soils are used for cropland. The Parnell, Tonka, and Parnell ponded soils are used for pasture or wetland wildlife habitat.

The main limitations for use of the major soils for farming are slope and the hazard of water erosion. The main limitations for most other uses are the moderately slow permeability of the Bottineau and Aastad soils, the moderate permeability of the Edgeley Variant soils, and slope.

These soils have poor and very poor potential for wetland wildlife habitat. The Bottineau and Aastad soils have good potential for range. The Edgeley Variant soils have fair potential for range and poor potential for cultivated crops, most recreational uses, windbreaks, and most residential and urban uses. The gently sloping and undulating areas of this map unit have good potential for cultivated crops and most recreational uses, and the gently rolling and rolling areas have fair potential for cultivated crops and most recreational uses. The undulating to rolling areas have good potential for windbreaks and fair potential for most residential and urban uses. Potential for wetland wildlife habitat is good on the Parnell ponded, Parnell, and Tonka soils.

Soils formed in lacustrine and eolian sediment on lake plains

The soils of these three map units are mainly on level and nearly level lake plains, but some are on rolling eolian-mantled lake plains. The soils formed under grassland vegetation. These map units make up about 9 percent of the survey area.

8. Maddock-Hecla-Embden

Deep, nearly level to rolling or strongly sloping, well drained and moderately well drained, moderately coarse textured and coarse textured soils formed in sandy eolian or outwash materials and lacustrine sediment

These soils are on sandy plains and sand mantled glacial moraines. They are characterized by ridges, knolls, gentle rises, and narrow to broad swales.

This map unit makes up about 2 percent of the survey area. It is about 22 percent Maddock soils, 20 percent Hecla soils, 8 percent Embden soils, and 50 percent water or soils of minor extent.

The nearly level to strongly sloping, well drained Maddock soils are on the tops of gentle rises, knolls, and ridges. The nearly level and gently sloping Hecla soils and the nearly level to gently rolling Embden soils are in swales.

The minor soils in this map unit are the Dickey, Fossum, Heimdal, Stirum, and Towner soils. The well drained Dickey soils are on the same landscape position as the Maddock soils and are in small areas underlain by loam and clay loam glacial till. The well drained Heimdal soils are on upper side slopes. The poorly drained Fossum soils and sodic Stirum soils are in deeper areas of swales below the Hecla and Embden soils. The moderately well drained Towner soils are on the same landscape position as the Hecla and Embden soils and are in small areas underlain by loam and clay loam glacial till. Parnell ponded soils and some areas of water are also in this unit.

Most areas of these soils are used for cropland, but the moderately sloping, strongly sloping, and poorly drained soils are used for hay and pasture. The Dickey, Heimdal, and Towner soils are used for cropland. The Dickey soils, in moderately sloping and strongly sloping areas, and the Fossum, Stirum, and Parnell ponded soils are used for pasture and hay production or wetland wildlife habitat. The main limitations for use of the major soils for farming are the hazards of water erosion and soil blowing and low available water capacity. The rapid permeability of the Maddock and Hecla soils and the moderately rapid permeability of the Embden soils are the main limitations for most other uses.

These soils have poor and very poor potential for wetland wildlife habitat. Maddock soils have poor potential for cultivated crops, fair potential for range and most recreational uses, and fair potential for windbreaks. There is good potential for most residential and urban uses on the nearly level to moderately sloping areas and fair potential on the strongly sloping areas. On Hecla soils, potential is poor for cultivated crops, fair for range and most recreational uses, fair for most residential and urban uses, and good for windbreaks. Embden soils have good potential for range and most recreational uses. The nearly level and undulating areas have good potential for cultivated crops and windbreaks, and the gently rolling areas have fair potential for these uses. The Parnell ponded soils have good potential for wetland wildlife habitat.

9. Overly-Bearden-Fargo

Deep, level to gently sloping, moderately well drained to poorly drained, medium textured and moderately fine textured soils formed in silty, clayey, and loamy lacustrine sediment

These soils are on glacial lake plains with gentle rises; broad, gentle swells; and swales. A few small, deep depressions are in the swales.

This map unit makes up about 1 percent of the survey area. It is about 23 percent Overly soils, 20 percent Bearden soils, 12 percent Fargo soils, and 45 percent water or soils of minor extent.

The nearly level, moderately well drained Overly soils are on gentle rises and higher swells. The level, somewhat poorly drained Bearden soils are on gentle swells and in shallow swales. The level, poorly drained Fargo soils are in deeper swales.

The minor soils in this map unit are the Aberdeen, Gardena, Grano, Hamerly, Hegne, Parnell, Svea, and Tonka soils. The moderately well drained Aberdeen soils are sodic soils on swells and are slightly below the Overly soils. The moderately well drained Gardena soils are on the same landscape position as the Overly soils. The moderately well drained Svea soils and the somewhat poorly drained Hamerly soils are on similar positions to those of the Overly and Bearden soils in small areas of loam and clay loam glacial till. The poorly drained and very poorly drained Grano soils and poorly drained Hegne soils are on the same landscape position as the Fargo soils. The poorly drained Tonka soils and very poorly drained Parnell soils are in deep depressions. Parnell ponded soils and some areas of water are also in this unit.

Most of the soils in this unit are used for cropland, as are the Aberdeen, Gardena, Hamerly, Hegne, and Svea soils. The Grano, Parnell, Parnell ponded, and Tonka soils are used for pasture and hay production or wetland wildlife habitat.

The main limitations for use of the major soils for farming are the hazard of soil blowing and wetness. The main limitations for most other uses are the seasonal high water table and wetness of the Bearden and Fargo soils, the moderately slow permeability of the Overly and Bearden soils, and the slow permeability of the Fargo soils.

These soils have good potential for cultivated crops, range, and windbreaks. The Overly soils have fair potential for most engineering and recreational uses and poor potential for wetland wildlife habitat. The Bearden soils have poor potential for most engineering uses and fair potential for most recreational uses and wetland wildlife habitat. The Fargo soils have poor potential for most engineering and recreational uses and good potential for wetland wildlife habitat. Potential for wetland wildlife habitat is good on the Parnell ponded, Grano, Parnell, and Tonka soils.

10. Lallie-Minnewaukan

Deep, level and nearly level, very poorly drained and poorly drained, coarse textured and medium textured soils formed in clayey and sandy lacustrine sediment

These soils are in dry lake basins with broad, flat plains dissected by slightly higher beaches and sandbars.

This map unit makes up about 6 percent of the survey area. It is about 42 percent Lallie soils, 20 percent Minnewaukan soils, and 38 percent water or soils of minor extent.

The level, poorly drained and very poorly drained Lallie soils are on broad, flat plains. The nearly level, poorly drained Minnewaukan soils are adjacent to beaches and are on sandbars.

The minor soils in this map unit are the Sioux soils, which are excessively drained and are on beaches. Lallie ponded soils and some areas of water are also in the unit.

Most areas of these soils are used for hay and range, as are the Sioux soils. The Lallie ponded soils are used for wetland wildlife habitat.

The main limitations for use of the major soils for farming are the hazard of soil blowing and low natural fertility. The main limitations for most other uses are the seasonal high water table, wetness, and ponding of all the major soils.

These soils have fair potential for range and poor potential for cultivated crops and most residential, urban, and recreational uses. The Lallie soils have poor potential for windbreaks and good potential for wetland wildlife habitat. The Minnewaukan soils have good potential for windbreaks and poor potential for wetland wildlife habitat. Potential for wetland wildlife habitat is good on the Lallie ponded soils.

Soils formed in glacial outwash on terraces and uplands

The soils of these two map units are mainly on nearly level to moderately steep glacial outwash terraces, but some are on hilly ridges. The soils formed under grassland vegetation. These units make up about 8 percent of the survey area.

11. Renshaw-Arvilla-Fordville

Deep, nearly level and gently sloping, well drained and somewhat excessively drained, moderately coarse textured and medium textured soils formed in loamy sediment over sand and gravel

These soils are on glacial outwash plains and stream terraces. The areas are characterized by ridges, knolls, and swales.

This map unit makes up about 5 percent of the survey area. It is about 20 percent Renshaw soils, 20 percent Arvilla soils, 15 percent Fordville soils, and 45 percent water or soils of minor extent.

The nearly level and gently sloping, somewhat excessively drained Renshaw and Arvilla soils are on side slopes and tops of knolls and ridges. The nearly level, well drained Fordville soils are in shallow swales.

The minor soils in this map unit are the Divide and Marysland soils. The somewhat poorly drained Divide soils and the poorly drained and very poorly drained Marysland soils are in the deep, lower lying swales. Parnell ponded soils and some areas of water are also in this unit.

Most areas of these soils are used for cropland, as are the Divide soils and poorly drained areas of the Marysland soils. The very poorly drained areas of the Marysland soils and Parnell ponded soils are used for pasture and hay production or wetland wildlife habitat.

The main limitations for use of the major soils for farming are the hazards of water erosion and soil blowing and low available water capacity. The main limitations for most other uses are the rapid permeability of the Renshaw and Arvilla soils and the moderate permeability in the upper part of the Fordville soils and rapid permeability in the underlying material.

The major soils have very poor potential for wetland wildlife habitat and good potential for recreational uses and most residential and urban uses. The Renshaw and Arvilla soils have poor potential for cultivated crops and windbreaks and fair potential for range. The Fordville soils have fair potential for cultivated crops and good potential for range and windbreaks. Potential for wetland wildlife habitat is good on the Parnell ponded and Marysland soils.

12. Brantford-Vang-Coe

Deep, nearly level to moderately steep, well drained and excessively drained, medium textured soils formed in loamy sediment over sand and gravel that is predominantly shale

These soils are on glacial moraines, glacial outwash plains, and stream terraces. These areas are characterized by hills, ridges, and knolls dissected by swales.

This map unit makes up about 3 percent of the survey area. It is about 41 percent Brantford soils, 12 percent Vang soils, 12 percent Coe soils, and 35 percent water or soils of minor extent.

The nearly level to moderately sloping, well drained Brantford soils are on side slopes and tops of lower knolls and ridges. The nearly level and gently sloping, well drained Vang soils are in shallow swales. The nearly level to moderately steep, excessively drained Coe soils are on hilltops and higher knolls and ridges.

The minor soils in this map unit are the Divide and Marysland soils. The somewhat poorly drained Divide soils and the poorly drained and very poorly drained Marysland soils are in deep, lower lying swales. Parnell ponded soils and some areas of water are also in this unit.

Most areas of these soils are used for cropland, as are the Divide soils and poorly drained areas of the Marysland soils. Areas of Coe soils are used for hay and range. The very poorly drained areas of the Marysland soils and Parnell ponded soils are used for pasture or wetland wildlife habitat.

The main limitations for use of the major soils for farming are the hazards of water erosion and soil blowing and low available water capacity. The main limitations for most other uses are the moderate permeability

in the upper part and very rapid permeability in the underlying material of all the major soils.

These soils have very poor potential for wetland wildlife habitat. The Brantford soils have poor potential for cultivated crops and windbreaks, fair potential for range, and good potential for recreational uses and for most residential and urban uses. The Vang soils have fair potential for cultivated crops and good potential for range, windbreaks, recreational uses, and most residential and urban uses. The Coe soils have poor potential for cultivated crops and windbreaks; good potential for most residential and urban uses in nearly level to moderately sloping areas; and fair potential for range, most recreational uses, and for most residential and urban uses in strongly sloping and moderately steep areas. Potential for wetland wildlife habitat is good on the Parnell ponded and Marysland soils.

Soils formed in alluvial sediment and glacial till on bottom lands and adjacent uplands

The soils in this map unit are on level and nearly level flood plains and very steep, dissected, glacial till plains.

The soils formed under grassland vegetation. This unit makes up about 2 percent of the survey area.

13. Esmond-LaDelle-Ryan

Deep, level to very steep, poorly drained, moderately well drained, and well drained, medium textured and fine textured soils formed in loam glacial till and loamy and clayey alluvium

These soils are on breaks, side slopes, and bottom lands of the Sheyenne River. The breaks are characterized by steep stony slopes with many deep swales and coulees. The bottom lands are characterized by level and nearly level flood plains, alluvial fans, depressions, old river channels, and oxbows.

This map unit makes up about 2 percent of the survey area. It is about 30 percent Esmond soils, 15 percent LaDelle soils, 10 percent Ryan soils, and 45 percent water or soils of minor extent.

The moderately sloping to very steep, well drained Esmond soils are on valley side slopes. The level, poorly drained Ryan soils are sodic soils and are in slight depressions. The level and nearly level, moderately well drained LaDelle soils are on slightly convex positions on the bottom lands (fig. 5).

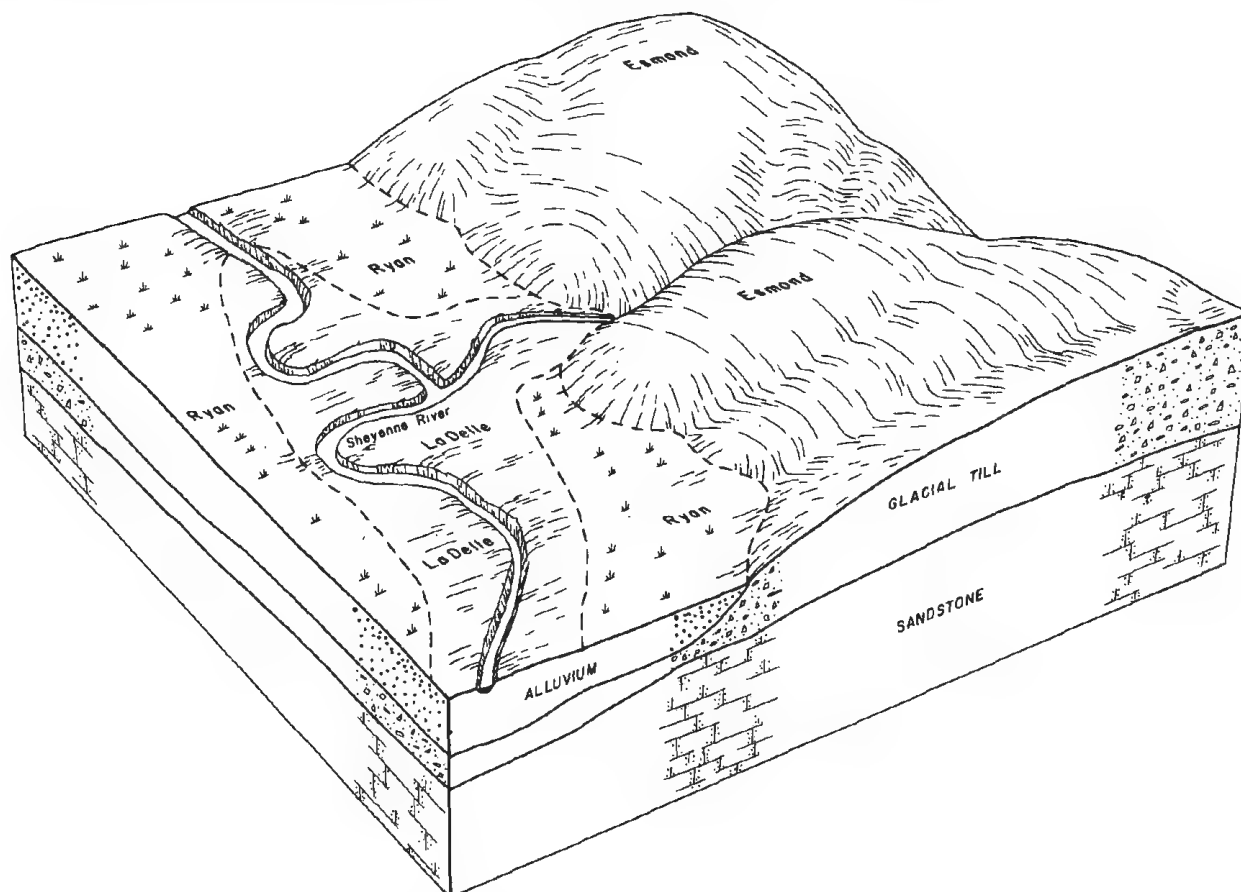


Figure 5.—Parent material and position of soils in the Esmond-LaDelle-Ryan map unit.

The minor soils in this map unit are the Darnen and Rauville soils. The very poorly drained Rauville soils are in low areas in old river channels and oxbows on the bottom lands. The moderately well drained Darnen soils are on foot slopes and toe slopes between the valley sides and bottom lands. Parnell ponded soils and some areas of water are also in this unit.

Most areas of these soils are used for range (fig. 6). The LaDelle soils on higher bottom lands and Darnen soils on toe slopes of breaks are used for cropland. Rauville and Parnell ponded soils are used for range or wetland wildlife.

The main limitations for use of the Esmond soils are the hazard of water erosion and stoniness. The main limitations for most uses are spring flooding, the seasonal high water table, and wetness.

These soils have poor potential for recreational uses and most residential and urban uses and good potential for range and wetland wildlife habitat. The Esmond and Ryan soils have poor potential for cultivated crops, and LaDelle soils have good potential for cultivated crops. Potential for wetland wildlife habitat is good on the Parnell ponded and Rauville soils.

Broad land use considerations

The general soil map is most useful for determining the general outline of areas that are suitable for cropland, urban areas, wildlife, or recreational use; it cannot be used for the selection of sites for specific structures. Deciding which land to use for urban development or, for example, which land to preserve for cropland is an issue of increasing concern in the state and in the survey area.

The 1970 Conservation Needs Inventory shows that in 1967, 77.7 percent of the land in Benson County Area was used for crops, 12.6 percent for rangeland, 4.9 percent for pasture, 1.9 percent for forest land, and 2.8 percent for other uses. In general, the soils that have good potential for cultivated crops also have good potential for urban development. The information about specific soils in this survey can be helpful in planning future land use patterns in Benson County Area.

Large areas where the soils are so unfavorable that urban or recreational development is prohibited are not extensive in the Benson County Area; however, the Lallie-Minnewaukan map unit is subject to inundation because of the fluctuating levels of Devils Lake. The Renshaw-Arvilla-Fordville and the Brantford-Vang-Coe map units are made up of soils that are rapidly permeable, and there is a possibility of groundwater contamination if the soils are used for onsite sewage disposal. Each unit contains small acreages of poorly drained and very poorly drained soils. These soils are so wet that they have poor potential for urban uses.

For cultivated crops, Emrick-Heimdal-Fram and the Svea-Barnes-Hamerly map units have high potential and are the most productive soils, the Lallie-Minnewaukan unit has low potential and is the least productive, and the other units have fair potential and are productive.

Soil maps for detailed planning

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and po-



Figure 6.—Most of the LaDelle and Ryan soils (foreground) and Esmond soils (background) are used for rangeland.

tential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Hecla fine sandy loam, 1 to 3 percent slopes, is one of several phases in the Hecla series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Embden-Heimdal complex, 1 to 3 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Colvin and Borup silt loams, saline, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. Miscellaneous

areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

3—Parnell silty clay loam. This deep, level, very poorly drained soil is in depressions on glacial till plains and lake plains. Individual areas of this map unit are 2 to 40 acres.

Typically, the surface layer is black silty clay loam about 14 inches thick. The subsoil, from 14 to 36 inches, is black silty clay. The underlying material, from 36 to 60 inches, is dark gray silty clay loam in the upper part and olive gray silty clay loam in the lower part.

Included with this soil in mapping, and making up 10 to 20 percent of the map unit, are small areas of the poorly drained Tonka and Vallery soils. The Tonka soil has a light colored subsurface layer and is in the shallower part of the depressions. The Vallery soil has layers of lime accumulation within a depth of 16 inches and is in the margins of the depressions.

This Parnell soil has slow permeability. Available water capacity is high, and runoff is ponded. Early in spring and after rainy periods a high water table develops, resulting in wetness and surface ponding. In most years, the high water table exists throughout most of summer and occasionally into fall. Susceptibility to soil blowing is low.

Most areas of this soil are used for wetland wildlife habitat. The potential is good for wetland wildlife habitat and is fair for range. The potential is poor for crops, windbreaks, and most engineering and recreational uses. It is generally not feasible to cultivate this soil because of wetness, surface ponding of water, and the absence of suitable outlets.

This soil is suited to pastureland or rangeland. Overgrazing or grazing when the soil is wet causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is generally unsuited to sanitary facilities and buildings. Wetness and flooding are severe limitations that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are generally nearby for buildings and sanitary facilities. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass Vw.

4—Fargo silty clay loam. This deep, level, poorly drained soil is on glacial lake plains. Individual areas of this map unit are 5 to 200 acres.

Typically, the surface layer is black silty clay loam about 12 inches thick. The subsoil, from 12 to 30 inches, is olive gray clay. The underlying material, from 30 to 60 inches, is olive gray silty clay in the upper part and olive and dark gray silty clay in the lower part. In places, the surface layer is clay loam, silty clay, or clay. In a few small areas the underlying material is clay loam glacial till.

Included with this soil in mapping, and making up 15 to 20 percent of the map unit, are small areas of the poorly drained Hegne soil. Layers of lime accumulation are within a depth of 16 inches and are on some of the swells.

This Fargo soil has slow permeability. Available water capacity is high, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. Susceptibility to soil blowing is low.

Most areas of this soil are used for cultivated crops. The potential is good for crops, range, windbreaks, and wetland wildlife habitat. The potential is poor for most engineering and recreational uses.

This soil is well suited to wheat, oats, barley, flax, and grass-legume hay. Maintaining good soil tilth and overcoming wetness are the main management concerns. Adequate outlets for drainage water are often difficult to locate. Use of crop residue and maintaining surface drains help alleviate these limitations.

This soil is well suited to pastureland or rangeland. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is poorly suited to sanitary facilities and buildings. Reinforcing foundations and basement walls of dwellings helps overcome the shrink-swell limitation. Installation of foundation drainage for buildings helps minimize wetness. Alternate sites are needed for septic tanks. Better suited sites for buildings are generally nearby. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass IIw.

5—Hegne silty clay. This deep, level, poorly drained soil is on glacial lake plains. Individual areas of this map unit are 5 to 200 acres.

Typically, the surface layer is black silty clay about 8 inches thick. The next layer is very dark gray and dark gray silty clay and is 8 to 10 inches thick. The underlying material from 10 to 60 inches, is gray silty clay in the upper part, olive gray silty clay in the middle part, and

olive gray and dark gray clay in the lower part. In a few small areas, the underlying material is clay loam glacial till. In some places there are no layers of lime accumulation in the upper 16 inches, and within these areas, in some places, there is a subsoil.

This soil has very slow permeability. Available water capacity is moderate, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. Susceptibility to soil blowing is high.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is good for crops, range, and windbreaks. The potential is fair for wetland wildlife habitat and poor for most engineering and recreational uses.

This soil is well suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management problems are wetness, controlling soil blowing, and maintaining good soil tilth. Adequate outlets for drainage water are often difficult to locate. Maintaining surface drains helps reduce wetness. Intensive use of field windbreaks, annual buffer strips, and stubble mulching help control soil blowing. Use of crop residue helps maintain good soil tilth.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is poorly suited to sanitary facilities and buildings. Wetness is a severe limitation that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are needed for building sites and related uses. This soil is suited to wetland wildlife habitat.

This map unit is in capability subclass IIw.

7—Colvin silt loam. This deep, level, poorly drained soil is on glacial lake plains, in drainageways, and is adjacent to old stream channels. Individual areas of this map unit are 5 to 150 acres.

Typically, the surface layer is black silt loam in the upper part, very dark gray silt loam in the lower part, and about 12 inches thick. The underlying material, from 12 to 30 inches, is dark gray silty clay loam. It is dark gray silty clay loam and olive gray and olive loam to a depth of 60 inches. In places, the surface layer is silty clay loam, and in a few places the soil is moderately saline.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of

the somewhat poorly drained Bearden soil on higher swells.

This Colvin soil has moderately slow permeability. Available water capacity is high, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. Susceptibility to soil blowing is high.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is good for crops, range, windbreaks, and wetland wildlife habitat. The potential is poor for most engineering and recreational uses.

This soil is well suited to wheat, oats, barley, flax, and grass-legume hay. Wetness and soil blowing are the main limitations when this soil is tilled. Adequate outlets for drainage are often difficult to locate. Maintaining surface drains and intensive use of field windbreaks, strip-cropping, and annual buffer strips help alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

Where drained, this soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings. Undrained areas are not suited to these uses.

This soil is poorly suited to sanitary facilities and buildings. Wetness is a severe limitation that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass IIw.

8—Colvin silt loam, wet. This deep, level, very poorly drained soil is on glacial lake plains and is adjacent to old stream channels. Some areas have hummocks about 1 foot high and 3 feet in diameter. Individual areas of this unit are 5 to 200 acres.

Typically, the surface layer is black silt loam in the upper part, very dark gray silt loam in the lower part, and about 12 inches thick. The underlying material, from 12 to 30 inches, is dark silty clay loam. To a depth of 60 inches, it is dark gray silty clay loam and olive gray and olive loam. In places, the surface layer is silty clay loam. In other places, the soil is black or very dark gray below a depth of 12 inches.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the poorly drained Borup soil. This soil contains less clay and is in the same landscape position as the Colvin soil.

This Colvin soil has moderately slow permeability. Available water capacity is high, and runoff is slow. Early in spring and after heavy rainy periods this soil is ponded. The water table is near the surface throughout most of the year. Susceptibility to soil blowing is high.

Most areas of this soil are used for range, pasture, and wetland wildlife habitat. The potential is fair for range and is good for wetland wildlife habitat. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. It is not feasible to cultivate this soil because of wetness, surface ponding of water, and the absence of suitable outlets.

Using this soil for pastureland or rangeland helps control erosion. Grazing when the soil is wet causes surface compaction and poor soil tilth. Proper stocking rates and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to sanitary facilities and buildings because of wetness and flooding. Outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass Vw.

9—Rauville silt loam. This deep, level, very poorly drained soil is on stream bottom lands and in drainageways on glacial till plains. Some areas have hummocks about 1 foot high and 3 feet in diameter. Individual areas of this map unit are 5 to 225 acres.

Typically, the surface layer is about 42 inches thick. It is black silt loam in the upper part and very dark gray and very dark grayish brown silty clay loam in the lower part. The underlying material, from 42 to 60 inches, is olive gray silty clay loam. In places, the surface layer is thinner and has a layer of sand at a depth of 20 to 30 inches; in other places the surface layer is silty clay loam.

This soil has moderately slow permeability. Available water capacity is high, and runoff is slow. Early in spring and after heavy rainy periods this soil is ponded. The water table is near the surface throughout most of the year. Susceptibility to soil blowing is high.

Most areas of this soil are used for range and wetland wildlife habitat. The potential is good for wetland wildlife habitat and is fair for range. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. It is not feasible to cultivate this soil because of wetness, surface ponding of water, and the absence of suitable outlets.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing and grazing when the soil is wet causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to sanitary facilities and buildings. Wetness and flooding are severe limitations that

can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass Vw.

11—Svea-Barnes loams, 1 to 3 percent slopes. This map unit consists of deep, nearly level soils on glacial till plains. The moderately well drained Svea soil is in swales and on the concave lower side slopes and is 40 to 60 percent of the map unit. The well drained Barnes soil is on rises and is 30 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 250 acres.

Typically, the Svea soil has a surface layer of black loam about 12 inches thick. The subsoil, from 12 to 22 inches, is very dark grayish brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 22 to 60 inches, is grayish brown loam.

Typically, the Barnes soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 18 inches, is dark brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 18 to 60 inches, is grayish brown loam in the upper part and light olive brown loam in the lower part.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the somewhat poorly drained Hamerly soil, the very poorly drained Parnell soil, and the poorly drained Tonka and Vallers soils. The Hamerly and Vallers soils have layers of lime accumulation within a depth of 16 inches and are around the margins of deep depressions. The Parnell and Tonka soils are in deep depressions.

The soils in this map unit have moderately slow permeability. Available water capacity is high, and runoff is slow. Susceptibility to soil blowing and water erosion is low.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, windbreaks, and recreational uses. The potential is fair for most engineering uses and is poor for wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. The main management concern is maintaining good soil tilth. Use of crop residue helps control this limitation.

These soils are well suited to pastureland or range-land. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the Svea soil. Nearly all climatically adapted species have the potential to grow well on the Barnes soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings on the Svea soil that can be minimized by the installation of foundation drainage or by locating such structures on the higher lying Barnes soil. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass Ilc.

12B—Barnes-Svea loams, 3 to 6 percent slopes.

This map unit consists of deep, gently sloping soils on glacial till plains and moraines. The well drained Barnes soil is on convex mid and upper side slopes and is 50 to 60 percent of the map unit. The moderately well drained Svea soil is in swales and on concave lower side slopes and is 40 to 50 percent of the map unit (fig. 7). Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the Barnes soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 18 inches, is dark brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 18 to 60 inches, is grayish brown loam in the upper part and light olive brown loam in the lower part. In places, the surface layer has up to 10 percent stones, and in other places, generally on light colored knolls, the surface layer is thinner and the subsoil is lacking.

Typically, the Svea soil has a surface layer of black loam about 12 inches thick. The subsoil, from 12 to 22 inches, is loam. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The underlying material, from 22 to 60 inches, is grayish brown loam.

Included with these soils in mapping, and making up as much as 10 percent of the map unit, are small areas of the somewhat poorly drained Hamerly soil, the very poorly drained Parnell soil, and the poorly drained Tonka and Vallers soils. The Hamerly and Vallers soils are around the margins of deep depressions and have layers of lime accumulation within a depth of 16 inches. The Parnell and Tonka soils are in deep depressions.

The soils in this map unit have moderately slow permeability. Available water capacity is high, and runoff is



Figure 7.—Typical landscape showing Barnes soils on convex upper and side slopes, and Svea soils on lower slopes and in swales.

medium. Susceptibility to soil blowing is low and to water erosion is moderate.

Most areas of these soils are used for cultivated crops. The potential is good for crops, windbreaks, range, and recreational uses. The potential is fair for most engineering uses and is very poor for wetland wildlife habitat.

These soils are well suited to wheat, oats, flax, barley, and grass-legume hay. The main management concerns are maintaining good soil tilth and controlling water erosion. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the Svea soil. Nearly all climatically adapted species have the potential to grow well on the Barnes soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings on the Svea soil that can be minimized by the installation of foundation drainage or by locating such structures on the higher lying Barnes soil. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

13C—Barnes-Buse loams, 6 to 9 percent slopes.

This map unit consists of deep, gently rolling, well drained soils on glacial till plains and moraines. The Barnes soil is on side slopes and is 35 to 50 percent of the map unit. The Buse soil is on knolls and ridges and is 30 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 250 acres.

Typically, the Barnes soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 18 inches, is dark brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 18 to 60 inches, is grayish brown loam in the upper part and light olive brown loam in the lower part. In a few places the surface layer is black at a depth of 8 to 20 inches.

Typically, the Buse soil has a surface layer of very dark gray loam about 8 inches thick. The next layer is grayish brown loam and is 8 to 15 inches thick. The underlying material, from 15 to 60 inches, is light olive brown loam. In places, generally on the higher knolls and ridges, the surface layer is thinner and moderately eroded.

Included with these soils in mapping, and making up 15 to 20 percent of the map unit, are small areas of the moderately well drained Svea soil, the somewhat poorly drained Hamerly soil, the very poorly drained Parnell soil, and the poorly drained Tonka and Vallers soils. The Svea soil has a thicker subsoil and surface layer and is in swales and on the lower side slopes. The Hamerly and Vallers soils are around the margins of deep depressions and have layers of lime accumulation within a depth of 16 inches. The Parnell and Tonka soils are in deep depressions.

The soils in this map unit have moderately slow permeability. Available water capacity is high, and runoff is rapid. Susceptibility to soil blowing is low and to water erosion is high.

Most areas of these soils are used for cultivated crops. The potential is fair for crops, windbreaks, and most engineering uses. The potential is good for range and recreational uses and is very poor for wetland wildlife habitat.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. The main management concern is control of water erosion, and this can be reduced by proper placement of grassed waterways and use of crop residue.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Barnes soil is well suited to trees and shrubs in windbreaks and environmental plantings. Nearly all climatically adapted species grow well. The Buse soil is poorly suited to trees and shrubs in windbreaks and environmental plantings, but is suited to plantings for wildlife habitat, recreation, and beautification where survival, growth, and vigor are not required or expected to be optimum. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks that can be overcome by increasing the size of the absorption field. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. Alternate sites are needed for sewage lagoons. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

13D—Barnes-Buse loams, 9 to 15 percent slopes.

This map unit consists of deep, rolling, well drained soils on glacial till plains and moraines. The Barnes soil is on side slopes and is 35 to 50 percent of the unit. The Buse soil is on the hilltops and ridges and is 30 to 45 percent of the unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 125 acres.

Typically, the Barnes soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 18 inches, is dark brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 18 to 60 inches, is grayish brown loam in the upper part and light olive brown loam in the lower part. In a few places, the surface layer is stony. In other places the surface layer is black at a depth of 8 to 20 inches.

Typically, the Buse soil has a surface layer of very dark gray loam about 8 inches thick. The next layer, from 8 to 15 inches, is grayish brown loam. The underlying material, from 15 to 60 inches, is light olive brown loam. In places, generally on the higher hilltops and ridges, the surface layer is thinner and moderately eroded. In other places, the surface is stony.

Included with these soils in mapping, and making up 15 to 20 percent of the map unit, are small areas of the moderately well drained Svea soil, the very poorly drained Parnell soil, and the poorly drained Tonka soil. The Svea soil has a thicker subsoil and surface layer and is in swales and on the lower side slopes. The Parnell and Tonka soils are in deep depressions.

The soils in this map unit have moderately slow permeability. Available water capacity is high, and runoff is very rapid. Susceptibility to soil blowing is low and to water erosion is very high.

Most areas of these soils are used for native range and pasture. The potential is fair for crops, windbreaks, and most engineering and recreational uses. The potential is good for range and very poor for wetland wildlife habitat.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. When these soils are tilled, the main management problem is control of water erosion. Proper placement of grassed waterways and use of crop residue help reduce this limitation.

Using these soils for pastureland and rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Barnes soil is well suited to trees and shrubs in windbreaks and environmental plantings. Nearly all climatically adapted species grow well. The Buse soil is poorly suited to trees and shrubs in windbreaks and environmental plantings, but is suited to plantings for wildlife habitat, recreation, and beautification where survival, growth, and vigor are not required or expected to be optimum. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Slope is a limitation for buildings that can be overcome by cut and fill operations. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundation and basement walls. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IVe.

14—Svea-Hamerly loams, 1 to 3 percent slopes.

This map unit consists of deep, nearly level soils on glacial till plains. The moderately well drained Svea soil

is on rises and is 35 to 55 percent of the map unit. The somewhat poorly drained Hamerly soil is in swales and on the concave lower side slopes and is 30 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the Svea soil has a surface layer of black loam about 12 inches thick. The subsoil, from 12 to 22 inches, is very dark grayish brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 22 to 60 inches, is grayish brown loam. In places, the soil is well drained and the black surface layer is less than 12 inches thick.

Typically, the surface layer of the Hamerly soil is loam about 9 inches thick. It is black in the upper part and very dark gray in the lower part. The underlying material, from 9 to 22 inches, is grayish brown and brown clay loam. From 22 to 60 inches, it is light olive brown loam. In places, generally around the rims of deep depressions, the soil is poorly drained.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the moderately well drained Cresbard soil, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Cresbard soil contains excess sodium in the subsoil and is in the same landscape position as the Svea soil. The Tonka and Parnell soils are in deep depressions.

The soils in this map unit have moderately slow permeability. Available water capacity is high, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops in the Hamerly soil, resulting in wetness. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, and windbreaks. The potential is fair for most engineering and recreational uses and poor for wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are maintaining good soil tilth and controlling soil blowing. Use of crop residue and intensive use of field windbreaks, annual buffer strips, and stubble mulching help alleviate these limitations.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings that can be minimized by the installation of foundation drainage. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

14B—Svea-Hamerly loams, 3 to 6 percent slopes.

This map unit consists of deep, gently sloping soils on glacial till plains. The moderately well drained Svea soil is on side slopes and is 35 to 55 percent of the map unit. The somewhat poorly drained Hamerly soil is in swales and on the concave lower side slopes and is 30 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the Svea soil has a surface layer of black loam about 12 inches thick. The subsoil, from 12 to 22 inches, is very dark grayish brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 22 to 60 inches, is grayish brown loam. In places the soil is well drained and the black surface layer is less than 12 inches thick.

Typically, the surface layer of the Hamerly soil is black loam in the upper part and very dark gray loam in the lower part and is 9 inches thick. The underlying material, from 9 to 22 inches, is grayish brown and brown clay loam. From 22 to 60 inches, it is light olive brown loam.

Included with these soils in mapping, and making up 15 to 20 percent of the map unit, are small areas of the well drained Buse soil, the moderately well drained Cresbard and Cavour soils, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Buse soil is on upper side slopes and on crests of knolls. The Tonka and Parnell soils are in deep depressions. The Cresbard and Cavour soils are in the same landscape position as the Svea soil, and contain excess sodium in the subsoil.

The soils in this map unit have moderately slow permeability. Available water capacity is high, and runoff is medium. Susceptibility to soil blowing is high and to water erosion is moderate.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, and windbreaks. The potential is fair for most engineering and recreational uses and is very poor for wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are maintaining good soil tilth and controlling soil blowing and water erosion. Use of crop residue, planting grassed waterways, and windbreaks help control erosion.

Using these soils for rangeland or pastureland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings that can be minimized by the installation of foundation drainage or by locating such structures on the higher lying included Buse soil. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

15—Vallers loam, saline, 1 to 3 percent slopes. This deep, nearly level, poorly drained, moderately saline soil is on glacial till plains. Individual areas of this map unit are 5 to 450 acres.

Typically, the surface layer is black loam about 9 inches thick. The underlying material, from 9 to 22 inches, is gray and olive gray clay loam. From 22 to 60 inches, it is olive gray and gray clay loam. In places the surface layer is clay loam. In other places the soil is slightly saline or strongly saline. In addition, the soil is somewhat poorly drained in places.

Included with this soil in mapping, and making up 10 to 20 percent of the map unit, are small areas of the moderately well drained Cresbard and Cavour soils, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Cresbard and Cavour soils contain excess sodium in the subsoil and are on the higher rises. The Tonka and Parnell soils are in deep depressions.

This Vallers soil has moderately slow permeability. Available water capacity is moderate, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness. The soil's high salt content restricts plant growth. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of this soil are used for cultivated crops, hay, and range. The potential is fair for crops, range, and wetland wildlife habitat. The potential is poor for windbreaks and for most engineering and recreational uses.

This soil is suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are wetness, salinity, and control of soil blowing. Adequate outlets for drainage water are often difficult to locate. Maintaining surface drains helps

reduce wetness. Planting saline-tolerant crops, avoiding summer fallow, and avoiding deep tillage help reduce salinity. Intensive use of annual buffer strips and stubble mulching help alleviate soil blowing.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to sanitary facilities and buildings. Wetness is a severe limitation which can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Salinity is a limitation that hinders landscaping. Alternate sites are needed for buildings and related uses. This soil is suited to wetland wildlife habitat.

This map unit is in capability subclass IIIw.

16—Vallers loam. This deep, nearly level, poorly drained soil is on glacial till plains. Individual areas of this map unit are 5 to 100 acres.

Typically, the surface layer is black loam about 9 inches thick. The underlying material, from 9 to 22 inches, is gray and olive gray clay loam. From 22 to 60 inches, it is olive gray and gray clay loam. In places, the surface layer is clay loam, and in places the surface has 1 to 10 percent cover of stones. In other places, the soil is somewhat poorly drained and is moderately saline.

Included with this soil in mapping, and making up as much as 20 percent of the map unit, are small areas of the poorly drained Tonka soil and the very poorly drained Parnell soil. They are in deep depressions.

This Vallers soil has moderately slow permeability. Available water capacity is high, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. Susceptibility to soil blowing is high.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is good for crops, range, windbreaks, and wetland wildlife habitat. The potential is poor for most engineering and recreational uses.

This soil is well suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are wetness and control of soil blowing. Adequate outlets for drainage water are often difficult to locate. Maintaining surface drains and intensive use of field windbreaks, annual buffer strips, and stubble mulching help alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

If drained, this soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is

good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings. Undrained areas are not suited to these uses.

This soil is poorly suited to sanitary facilities and buildings. Wetness is a severe limitation that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass IIw.

18E—Buse loam, 15 to 25 percent slopes. This deep, hilly, well drained soil is on glacial moraines and coulee breaks. On moraines, the drainageways extend to concave lower side slopes and swales. The swales occasionally contain small deep depressions. Individual areas of this map unit are 10 to 400 acres.

Typically, the surface layer is very dark gray loam about 8 inches thick. The underlying material, from 8 to 15 inches, is grayish brown loam and, from 15 to 60 inches, is light olive brown loam. In places, the surface layer is thicker and the subsoil is thin. In addition, in some places the soil is somewhat excessively drained and the surface layer is thinner.

Included with this soil in mapping, and making up 10 to 20 percent of the map unit, are small areas of the moderately well drained Svea soil, the very poorly drained Parnell soil, and the poorly drained Tonka soil. The Svea soil has a subsoil and a thicker surface layer and is in drainageways, on the lower side slopes, and in swales. The Parnell and Tonka soils are in deep depressions.

This Buse soil has moderately slow permeability. Available water capacity is high, and runoff is very rapid. Susceptibility to soil blowing is high and to water erosion is very high.

Most areas of this soil are used for range. The potential is poor for crops, windbreaks, and most engineering and recreational uses. The potential is fair for range and is very poor for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of slope and the high hazards of water erosion and soil blowing.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

Because of slope, this soil is poorly suited to trees and shrubs in windbreaks and environmental plantings. It is suited to plantings for wildlife habitat, recreation, and beautification where survival, growth, and vigor are not required or expected to be optimum.

This soil is poorly suited to sanitary facilities and buildings because of slope. Alternate sites are needed for buildings and related uses. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass VIIe.

19—Tonka silt loam. This deep, level, poorly drained soil is on glacial till and lake plains. Individual areas of this map unit are 2 to 40 acres.

Typically, the surface layer is black silt loam about 14 inches thick. The subsurface layer, from 14 to 22 inches, is dark gray silt loam. The subsoil, from 22 to 52 inches, is very dark grayish brown silty clay in the upper part and olive gray silty clay loam in the lower part. The underlying material, from 52 to 60 inches, is olive gray silty clay loam.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the somewhat poorly drained Fram and Hamerly soils, the poorly drained Vallers soil, and the very poorly drained Parnell soil. The Fram, Hamerly, and Vallers soils have layers of lime accumulation within a depth of 16 inches and are on the margins of depressions. The Parnell soil has no light colored subsurface layer, and is in the deeper part of depressions.

This Tonka soil has slow permeability. Available water capacity is high, and runoff is ponded. Early in spring and after heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. Susceptibility to soil blowing is moderate.

Most areas of this soil are used for hay and for wetland wildlife habitat. The potential is good for range, windbreaks, and wetland wildlife habitat. The potential is poor for crops and for most engineering and recreational uses.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. If the soil is tilled, the main management concerns are wetness and surface ponding. Adequate outlets for drainage water are often difficult to locate. Maintaining surface drains helps alleviate the management limitations.

This soil is well suited to pastureland or rangeland. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

If drained, this soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings. Undrained areas are not suited to these uses.

This soil is poorly suited to sanitary facilities and buildings. Wetness and flooding are severe limitations that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass IVw.

21—Emrick-Heimdal loams, 1 to 3 percent slopes.

This map unit consists of deep, nearly level soils on glacial till plains. The moderately well drained Emrick soil is in swales and on the lower side slopes and is 40 to 60 percent of the map unit. The well drained Heimdal soil is on rises and is 20 to 40 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to more than 400 acres.

Typically, the Emrick soil has a surface layer of black loam about 16 inches thick. The subsoil, from 16 to 34 inches, is very dark grayish brown loam. The underlying material, from 34 to 60 inches, is light olive brown loam in the upper and middle parts and olive brown loam in the lower part. In places, particularly the southwestern part of the county, the surface layer and subsoil are silt loam or very fine sandy loam. In parts of this area the underlying material has a higher clay content.

Typically, the Heimdal soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 19 inches, is very dark grayish brown loam in the upper part and dark brown or brown loam in the lower part. The underlying material, from 19 to 60 inches, is grayish brown loam in the upper part, yellowish brown loam in the middle part, and yellowish brown sandy clay loam in the lower part. In places, such as the southwestern part of the county, the surface layer and subsoil are silt loam or very fine sandy loam. In parts of this area the underlying material has a higher clay content.

Included with these soils in mapping, and making up 15 to 20 percent of the map unit, are small areas of the moderately well drained Cathay soil, the somewhat poorly drained Fram soil, the very poorly drained Parnell soil, and the poorly drained Tonka soil. The Cathay soil contains excess sodium in the subsoil. The Fram soil has layers of lime accumulation within a depth of 16 inches. The Cathay soil is in swales and is slightly below the Emrick soil. The Fram soil is on the margins of deep depressions. The Parnell and Tonka soils are in depressions.

The soils in this map unit have moderate permeability. Available water capacity is high, and runoff is slow. Susceptibility to soil blowing is moderate and to water erosion is low.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, windbreaks, and recreational uses. The potential is fair for most engineering uses and is poor for wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. The main management concern is the control of soil blowing. The use of field windbreaks, annual buffer strips, and stubble mulching helps alleviate this limitation.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant

vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species grow well on the Emrick soil. Nearly all climatically adapted species grow well on the Heimdal soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings. The soils in this map unit are suited to sanitary facilities and buildings. Sewage lagoons can be treated for seepage by sealing the bottom of the lagoon. In areas proposed for irrigation, onsite investigations can locate the more clayey underlying material. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

22B—Heimdal-Emrick loams, 3 to 6 percent slopes.

This map unit consists of deep, gently sloping soils on glacial till plains. The well drained Heimdal soil is on knolls and upper side slopes and is 40 to 60 percent of the map unit. The moderately well drained Emrick soil is in swales and on the lower side slopes and is 30 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to more than 400 acres.

Typically, the Heimdal soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 19 inches, is very dark grayish brown loam in the upper part and dark brown or brown loam in the lower part. The underlying material, from 19 to 60 inches, is grayish brown loam in the upper part, yellowish brown loam in the middle part, and yellowish brown sandy clay loam in the lower part. In places, particularly the southwestern part of the county, the surface layer and subsoil are silt loam or very fine sandy loam. In addition, parts of this area have underlying material with a higher clay content. In other places, generally on light colored knolls, the surface layer is thinner and there is no subsoil.

Typically, the Emrick soil has a surface layer of black loam about 16 inches thick. The subsoil, from 16 to 34 inches, is very dark grayish brown loam. The underlying material, from 34 to 60 inches, is light olive brown loam in the upper and middle parts and olive brown loam in the lower part. In places, particularly the southwestern part of the county, the surface layer and subsoil are silt loam or very fine sandy loam. In addition, parts of this area have underlying material with a higher clay content.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the moderately well drained Cathay soil, the somewhat poorly drained Fram soil, the very poorly drained Parnell soil, and the poorly drained Tonka soil. The Cathay soil contains excess sodium in the subsoil and is in swales slightly below the Emrick soil. The Fram soil

has layers of lime accumulation within a depth of 16 inches and is on the margins of deep depressions. The Parnell and Tonka soils are in depressions.

The soils in this map unit have moderate permeability. Available water capacity is high, and runoff is medium. Susceptibility to soil blowing and to water erosion is moderate.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, windbreaks, and recreational uses. The potential is fair for most engineering uses and is very poor for wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are control of soil blowing and water erosion. The use of field windbreaks, annual buffer strips, and stubble mulching helps alleviate soil blowing. Use of crop residue and planting of grassed waterways help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the Emrick soil. Nearly all climatically adapted species have the potential to grow well on the Heimdal soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. Sewage lagoons can be treated for seepage by sealing the bottom of the lagoon. In areas proposed for irrigation, onsite investigations can locate the area with more clayey underlying material. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

23C—Heimdal-Esmond loams, 6 to 9 percent slopes. This map unit consists of deep, gently rolling, well drained soils on glacial till plains and moraines. The Heimdal soil is on side slopes and is 35 to 50 percent of the map unit. The Esmond soil is on knolls and ridges and is 30 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 600 acres.

Typically, the Heimdal soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 19 inches, is very dark grayish brown loam in the upper part and dark brown or brown loam in the lower part. The underlying material, from 19 to 60 inches, is grayish brown loam in the upper part, yellowish brown loam in the middle part, and yellowish brown sandy clay loam in the lower part. In places, particularly the southwestern

part of the county, the surface layer and subsoil are silt loam or very fine sandy loam. In addition, parts of this area have underlying material with a higher clay content.

Typically, the Esmond soil has a surface layer of black loam about 9 inches thick. The underlying material, from 9 to 23 inches, is dark grayish brown and grayish brown loam. The underlying material, from 23 to 60 inches, is light olive brown loam. In places, particularly the southwestern part of the county, the surface layer and subsoil are silt loam or very fine sandy loam. In addition, parts of this area have underlying material with a higher clay content. In other places, generally on higher knolls and ridges, the surface layer is thinner and moderately eroded, and in places the surface is stony.

Included with these soils in mapping, and making up 15 to 20 percent of the map unit, are small areas of the moderately well drained Emrick soil, the very poorly drained Parnell soil, and the poorly drained Tonka soil. The Emrick soil has a thicker subsoil and surface layer and is in swales and on lower side slopes. The Parnell and Tonka soils are in deep depressions.

The soils in this map unit have moderate permeability. Available water capacity is high, and runoff is rapid. Susceptibility to soil blowing is moderate and to water erosion is high.

Most areas of these soils are used for cultivated crops. The potential is fair for crops, windbreaks, and most engineering uses. The potential is good for range and recreational uses and is very poor for wetland wildlife habitat.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are control of soil blowing and water erosion. The use of field windbreaks, annual buffer strips, and stubble mulching help alleviate soil blowing. Use of crop residue and planting of grassed waterways help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Heimdal soil is well suited to trees and shrubs in windbreaks and environmental plantings. Nearly all climatically adapted species grow well. The Esmond soil is poorly suited to trees and shrubs in windbreaks and environmental plantings, but is suited to plantings for wildlife habitat, recreation, and beautification where survival, growth, and vigor are not required or expected to be optimum. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to buildings and sanitary facilities. In areas proposed for irrigation, onsite investigations can locate more clayey underlying material. Alternate sites are needed for sewage lagoons.

These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

24—Fram-Emrick loams, 1 to 3 percent slopes. This map unit consists of deep, nearly level soils on glacial till plains. The somewhat poorly drained Fram soil is in swales and on the concave lower side slopes and is 35 to 50 percent of the map unit. The moderately well drained Emrick soil is on the rises and is 35 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 350 acres.

Typically, the surface layer of the Fram soil is black loam in the upper part, very dark gray loam in the lower part, and 13 inches thick. The underlying material, from 13 to 27 inches, is grayish brown loam. The underlying material, from 27 to 60 inches, is light olive brown loam and olive brown loam. In places, particularly the southwestern part of the county, the surface layer to the underlying material is silt loam or very fine sandy loam. In parts of this area there is a higher clay content in the underlying material. In other places the surface layer through the underlying material has higher clay content.

Typically, the Emrick soil has a surface layer of black loam about 16 inches thick. The subsoil, from 16 to 34 inches, is very dark grayish brown loam. The underlying material, from 34 to 60 inches, is light olive brown loam in the upper and middle parts and olive brown loam in the lower part. In places, particularly in the southwestern part of the county, the surface layer and subsoil are silt loam or very fine sandy loam. In addition, in parts of this area the underlying material has higher clay content. Some places are gently sloping.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the moderately well drained Cathay soil, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Cathay soil contains excess sodium in the subsoil and is in the same landscape position as the Emrick soil. Parnell and Tonka soils are in the depressions.

The soils in this map unit have moderate permeability. Available water capacity is high, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops in the Fram soil, resulting in wetness. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, and windbreaks. The potential is fair for most engineering and recreational uses and poor for wetland wildlife habitat.

This map unit is well suited to wheat, oats, barley, flax, and grass-legume hay. The main management concern is control of soil blowing. Intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate this problem.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This map unit is suited to sanitary facilities and buildings. On the Fram soil, wetness can be minimized by foundation drainage, or by locating structures on the higher lying Emrick soils. Sewage lagoons can be treated for seepage by sealing the bottom of the lagoon. In areas proposed for irrigation, onsite investigations can locate the areas with more clayey underlying material. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

25D—Esmond-Heimdal loams, 9 to 15 percent slopes. This map unit consists of deep, rolling, well drained soils on glacial till plains and moraines. The Esmond soil is on hilltops and ridges and is 35 to 50 percent of the map unit. The Heimdal soil is on side slopes and is 30 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the Esmond soil has a surface layer of black loam about 9 inches thick. The underlying material, from 9 to 23 inches, is dark grayish brown and grayish brown loam. The underlying material, from 23 to 60 inches, is light olive brown loam. In places, generally on higher hilltops and ridges, the surface layer is thinner and moderately eroded. In other places the surface is stony. The underlying material has higher clay content in places.

Typically, the Heimdal soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 19 inches, is very dark grayish brown loam in the upper part and dark brown or brown loam in the lower part. The underlying material, from 19 to 60 inches, is grayish brown loam in the upper part, yellowish brown loam in the middle part, and yellowish brown sandy clay loam in the lower part. In places, the underlying material has higher clay content.

Included with these soils in mapping, and making up 15 to 20 percent of the map unit, are small areas of the moderately well drained Emrick soil, the excessively drained Sioux soil, the very poorly drained Parnell soil, and the poorly drained Tonka soil. The Emrick soil has a thicker subsoil and surface layer and is in swales and on the lower side slopes. The Sioux soil has underlying material of sand and gravel at a depth of 9 inches and is

on some hilltops. The Parnell and Tonka soils are in depressions.

The soils in this map unit have moderate permeability. Available water capacity is higher, and runoff is very rapid. Susceptibility to soil blowing is moderate and to water erosion is very high.

Most areas of these soils are used for native range and pasture. The potential is fair for range, windbreaks, and for most engineering and recreational uses. The potential is poor for crops and is very poor for wetland wildlife habitat.

These soils are not suited to growing wheat, oats, barley, flax, and grass-legume hay because of slope and the high hazard of water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Esmond soil is poorly suited to growing trees and shrubs in windbreaks and environmental plantings, but is suited to plantings for wildlife habitat, recreation, and beautification where survival, growth, and vigor are not required or expected to be optimum. The Heimdal soil is well suited to growing trees and shrubs in windbreaks and environmental plantings. Nearly all climatically adapted species grow well. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. Slope is a limitation for buildings that can be overcome by cut and fill operations. Alternate sites are needed for sewage lagoons. These soils generally are not suited to wetland wildlife habitat.

This map unit is in capability subclass VIe.

25E—Esmond-Heimdal loams, 15 to 25 percent slopes. This map unit consists of deep, hilly, well drained soils on glacial moraines and coulee breaks. On the moraines, the drainageways extend to concave lower slopes and swales. The swales occasionally contain small, deep depressions. The Esmond soil is on hilltops and ridges and is 35 to 55 percent of the map unit. The Heimdal soil is on side slopes and is 30 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the Esmond soil has a surface layer of black loam about 9 inches thick. The underlying material, from 9 to 23 inches, is dark grayish brown and grayish brown loam. The underlying material, from 23 to 60 inches, is light olive brown loam. In places, generally on higher hilltops and ridges, the surface layer is thinner and moderately eroded. In other places the surface is stony, and in places the underlying material has higher clay content.

Typically, the Heimdal soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 19 inches, is very dark grayish brown loam in the upper part and dark brown or brown loam in the lower part. The underlying material, from 19 to 60 inches, is grayish brown loam in the upper part, yellowish brown loam in the middle part, and yellowish brown sandy clay loam in the lower part. In places the surface layer is stony. In other places, the underlying material has higher clay content.

Included with these soils in mapping, and making up 10 to 20 percent of the map unit, are small areas of the moderately well drained Emrick soil, the excessively drained Sioux soil, the very poorly drained Parnell soil, and the poorly drained Tonka soil. The Emrick soil has a thicker subsoil and surface layer and is in swales, on the lower side slopes, and in drainageways. The Sioux soil has underlying material of sand and gravel at a depth of 9 inches and is on some hilltops and ridges. The Parnell and Tonka soils are in depressions.

The soils in this map unit have moderate permeability. Available water capacity is high, and runoff is very rapid. Susceptibility to soil blowing is moderate and to water erosion is very high.

Most areas of these soils are used for range. The potential is poor for crops, windbreaks, and most engineering and recreational uses. The potential is fair for range and is very poor for wetland wildlife habitat. It is generally not feasible to cultivate these soils because of slope and the high hazard of water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Esmond soil is poorly suited to trees and shrubs in windbreaks and environmental plantings, but is suited to plantings for wildlife habitat, recreation, and beautification where survival, growth, and vigor are not required or expected to be optimum. The Heimdal soil is suited to trees and shrubs in windbreaks and environmental plantings. Nearly all climatically adapted species grow well. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are poorly suited to sanitary facilities and buildings because of the slope. Alternate sites are needed for buildings and related uses. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass VIe.

26E—Esmond-Sioux loams, 9 to 25 percent slopes. This map unit consists of deep, rolling, and hilly soils on glacial till plains, moraines, and eskers. The excessively drained Sioux soil is very shallow over sand and gravel. It is on hills and ridges dissected by narrow drainageways and makes up 25 to 45 percent of the map

unit. The well drained Esmond soil is on the upper side slopes, hilltops, and ridges and is 40 to 60 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Areas of this map unit are 5 to 300 acres.

Typically, the Esmond soil has a surface layer of black loam about 9 inches thick. The underlying material, from 9 to 23 inches, is dark grayish brown and grayish brown loam. The underlying material, from 23 to 60 inches, is light olive brown loam. In places there are more coarse fragments than normally found in this soil. In other places, generally on the side slopes, there is a subsoil, and in places the surface layer is thinner and moderately eroded.

Typically, the Sioux soil has a surface layer of black loam about 5 inches thick. The next layer, from 5 to 9 inches, is very dark grayish brown gravelly loam. The underlying material, from 9 to 60 inches, is dark brown, brown, and dark yellowish brown very gravelly sand. In places the soil is somewhat excessively drained, the surface layer is more than 5 inches thick, and the depth to sand and gravel is 9 to 20 inches.

Included with these soils in mapping, and making up 10 to 20 percent of the map unit, are small areas of the well drained Dickey and Maddock soils and the moderately well drained Emrick and Towner soils. The Dickey and Towner soils have a surface layer of fine sandy loam and underlying material of loam. The Maddock soil has a loamy fine sand and fine sandy loam surface layer and fine sand in the underlying material. The Emrick soil has a subsoil and a thicker surface layer. Towner soils are in swales, on the lower side slopes, and in drainageways.

Permeability in the Esmond soil is moderate, and available water capacity is high. Permeability in the Sioux soil is rapid, and available water capacity is very low. Runoff ranges from medium to very rapid. Susceptibility to soil blowing is moderate and to water erosion is high or very high.

Most areas of these soils are used for range. The potential is poor for crops, windbreaks, and most engineering and recreational uses. The potential is fair for range and is very poor for wetland wildlife habitat.

It is not feasible to cultivate the Sioux soil because of the slope, the hazard of water erosion, and the very low available water capacity.

Using these soils for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Esmond soil is poorly suited to trees and shrubs in windbreaks and environmental plantings because of slope. It is suited to plantings for wildlife habitat, recreation, and beautification where survival, growth, and vigor are not required or expected to be optimum. The Sioux

soil is not suited to these uses because of the very low available water capacity.

The soils in this map unit are poorly suited to sanitary facilities and buildings. Slope is a limitation for buildings that can be overcome by cut and fill operations in the areas having 9 to 15 percent slopes. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates on the Sioux soil. Alternate sites are needed for sewage lagoons, buildings, and septic tanks where there is 15 to 25 percent slopes. These soils are not suited to wetland wildlife habitat.

This map unit is in capability subclass VIe.

27C—Barnes-Sioux loams, 3 to 9 percent slopes.

This map unit consists of deep, gently sloping, and moderately sloping soils on glacial till plains and eskers. The excessively drained Sioux soil is very shallow over sand and gravel. It is on knolls and ridges and is 30 to 45 percent of the map unit. The well drained Barnes soil is on side slopes and is 35 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 125 acres.

Typically, the Barnes soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 18 inches, is dark brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 18 to 60 inches, is grayish brown loam in the upper part and light olive brown loam in the lower part. In places, more coarse fragments than normal are found in this soil. In other places, the surface layer is thinner and moderately eroded, and there is no subsoil.

Typically, the Sioux soil has a surface layer of black loam about 5 inches thick. The next layer, from 5 to 9 inches, is very dark grayish brown gravelly loam. The underlying material, from 9 to 60 inches, is dark brown, brown, and dark yellowish brown very gravelly sand. In places, more coarse sand and less gravel than normal are in this soil. The surface layer in places is moderately eroded. In other places, the soil is somewhat excessively drained, the surface layer is more than 5 inches thick, and the depth to sand and gravel is 9 to 20 inches.

Included with these soils in mapping, and making up 10 to 20 percent of the map unit, are small areas of the moderately well drained Svea soil. It has a thicker subsoil and surface layer and is in swales and on the lower slopes.

Permeability is moderately slow in the Barnes soil, available water capacity is high, and runoff is medium and rapid. Permeability is rapid in the Sioux soil, available water capacity is very low, and runoff is slow. Susceptibility to soil blowing is low and to water erosion is low to high.

Most areas of these soils are used for cultivated crops. The potential is fair for crops, windbreaks, and

most engineering uses. The potential is very poor for wetland wildlife habitat and good for range and recreational uses.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are the very low available water capacity on Sioux soil and the control of water erosion. Stubble mulching and high stubble can help low available water capacity. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management limitations. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Barnes soil is well suited to trees and shrubs in windbreaks and environmental plantings. Nearly all climatically adapted species have the potential to grow well. The Sioux soil is not suited to trees and shrubs in windbreaks and environmental plantings because of very low available water capacity. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The moderately slow permeability for septic tanks on the Barnes soil can be overcome by increasing the size of the absorption field. There is a possibility of septic tank effluent contaminating ground water supplies because of high seepage rates on the Sioux soil. On the Barnes soil, the shrink-swell limitation can be overcome by reinforcing foundations and basement walls or by locating structures on the Sioux soil. Alternate sites are needed for sewage lagoons on the Sioux soil and on areas having 7 to 9 percent slopes. These soils are not suited to wetland wildlife habitat.

This map unit is in capability subclass IVe.

28D—Barnes-Sioux loams, 9 to 15 percent slopes.

This map unit consists of deep, rolling soils on glacial till plains, moraines, and eskers. The excessively drained Sioux soil is very shallow over sand and gravel. It is on hilltops and ridges dissected by narrow drainageways and is 25 to 45 percent of the map unit. The well drained Barnes soil is on side slopes and is 40 to 60 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 300 acres.

Typically, the Barnes soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 18 inches, is dark brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 18 to 60 inches, is grayish brown loam in the upper part and light olive brown loam in the lower part. In places, more coarse fragments than normal are

found in this soil. In other places the surface layer is thinner and moderately eroded, and there is no subsoil.

Typically, the Sioux soil has a surface layer of black loam about 5 inches thick. The next layer, from 5 to 9 inches, is very dark grayish brown gravelly loam. The underlying material, from 9 to 60 inches, is dark brown, brown, and dark yellowish brown very gravelly sand. In places, more coarse sand and less gravel than normal are in this soil, and the surface layer is moderately eroded in some places. In other places, the soil is somewhat excessively drained, the surface layer is more than 5 inches thick, and the depth to sand and gravel is 9 to 20 inches.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the moderately well drained Svea soil. This soil has a thicker subsoil and surface layer and is in swales and on the lower side slopes.

Permeability is moderately slow in the Barnes soil, available water capacity is high, and runoff is very rapid. Permeability is rapid in the Sioux soil, available water capacity is very low, and runoff is medium. Susceptibility to soil blowing is low and to water erosion is high or very high.

Most areas of these soils are used for range. The potential is fair for range, windbreaks, and for most engineering and recreational uses. The potential is poor for crops and very poor for wetland wildlife habitat. It is generally not feasible to cultivate these soils because of slope, the high hazard of water erosion, and very low available water capacity on the Sioux soil.

Using these soils for pastureland or rangeland helps control erosion. The main management concerns are conserving soil moisture and overgrazing. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Barnes soil is well suited to trees and shrubs in windbreaks and environmental plantings. Nearly all climatically adapted species grow well. The Sioux soil is not suited to trees and shrubs in windbreaks and environmental plantings because of very low available water capacity. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The moderately slow permeability of the Barnes soil is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates on the Sioux soil. The slope limitation for buildings can be overcome by cut and fill operations. On the Barnes soil, the shrink-swell limitation can be overcome by reinforcing foundations and basement walls or by locating structures on the Sioux soil. Alternate sites are needed for sewage lagoons. These soils are not suited to wetland wildlife habitat.

This map unit is in capability subclass VIe.

30D—Barnes-Buse very stony loams, 6 to 25 percent slopes. This map unit consists of deep, gently rolling to hilly, well drained, very stony soils on glacial till plains and moraines. Stones, mainly on hills and ridges, cover 3 to 15 percent of the surface (fig. 8). The Barnes soil is on side slopes and is 35 to 45 percent of the map unit. The Buse soil is on hilltops and ridges and is 35 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 600 acres.

Typically, the Barnes soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 18 inches, is dark brown loam in the upper part and dark brown loam in the lower part. The underlying material, from 18 to 60 inches, is grayish brown loam in the upper part and light olive brown loam in the lower part.

Typically, the Buse soil has a surface layer of very dark gray loam about 8 inches thick. The underlying

material, from 8 to 15 inches, is grayish brown and, from 15 to 60 inches, is light olive brown loam. In places, generally on higher hilltops and ridges, the surface layer is thinner and in other places the stone cover is more than 25 percent. In places the soil is moderately eroded.

Included with these soils in mapping, and making up 15 to 20 percent of the map unit, are small areas of the moderately well drained Svea soil, the very poorly drained Parnell soil, and the poorly drained Tonka soil. The Svea soil has a thicker subsoil and surface layer and is in swales and on the lower side slopes. The Parnell and Tonka soils are in deep depressions.

The soils in this map unit have moderately slow permeability. Available water capacity is high, and runoff is rapid and very rapid. Susceptibility to soil blowing is low and to water erosion is high or very high.

Most areas of these soils are used for range. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. The potential is good for range and is very poor for wetland wildlife habitat. It



Figure 8.—Stones on the surface of the Barnes soil limit its use to rangeland

is generally not feasible to cultivate these soils because of slope and stoniness.

Using these soils for rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are generally not suited to trees and shrubs in windbreaks because of stoniness and slope. Environmental plantings for wildlife habitat, recreation, or beautification can be made if the trees and shrubs are hand-planted. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are poorly suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome in areas that have 6 to 15 percent slopes by enlarging the size of the absorption field. The presence of large stones is a limitation for buildings and septic tanks and can be minimized by removing the stones. Alternate sites are needed for buildings and septic tanks where areas have 15 to 25 percent slopes. These soils are not suited to wetland wildlife habitat.

This map unit is in capability subclass VI.

31B—Towner fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping, moderately well drained soil is on sand mantled glacial lake and till plains. Individual areas of this map unit are 5 to 150 acres.

Typically, the surface layer is black fine sandy loam about 8 inches thick. The subsoil, from 8 to 18 inches, is very dark grayish brown loamy fine sand. The underlying material, from 18 to 60 inches, is brown loamy fine sand in the upper part and light yellowish brown loam in the middle and lower parts. In places, generally on some of the higher knolls and rises, the surface layer is thinner and moderately eroded, and the surface in some areas has as much as 10 percent stone cover. In other places, the slopes are moderate, and in some areas the surface layer and subsoil are lighter in color, and the soil is well drained.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the well drained Esmond and Maddock soils and the moderately well drained Hecla soil. The Esmond soil has a loam surface layer. The Maddock and Hecla soils have loamy fine sand and fine sand underlying material. The Esmond soil is on the tops of some knolls and rises. The Maddock soil is on the upper side slopes. The Hecla soil is in some swales and drainageways.

This soil has rapid permeability in the upper part and moderately slow permeability in the lower part. Available water capacity is moderate, and runoff is slow. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is good for range, windbreaks, and recreational uses. The potential is fair for crops and most engineering uses and is poor for wetland wildlife habitat.

This soil is suited to wheat, oats, barley, flax, and grass-legume hay. When the soil is tilled, the main management concerns are low available water capacity and control of soil blowing. These limitations can be alleviated by leaving high stubble and by the intensive use of field windbreaks, annual buffer strips, and stubble mulching.

Using this soil for pastureland or rangeland helps control erosion. The main management concerns are conserving soil moisture and overgrazing. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings that can be minimized by foundation drainage or by locating structures on the higher lying areas. This soil is poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

33C—Dickey fine sandy loam, 6 to 9 percent slopes. This deep, gently rolling, well drained soil is on sand mantled glacial lake and till plains. Individual areas of this map unit are 5 to 150 acres.

Typically, the surface layer is black fine sandy loam about 8 inches thick. The subsoil, from 8 to 28 inches, is very dark grayish brown loamy fine sand in the upper part and brown loamy fine sand in the lower part. The underlying material, from 28 to 60 inches, is light yellowish brown loam in the upper part and light olive brown loam in the lower part. In places, generally on some of the higher knolls and ridges, the surface layer is thinner and moderately eroded, and the surface in some of these areas has as much as 10 percent stone cover. In other places, generally in swales and drainageways, the surface layer and subsoil are darker, and the soil is moderately well drained.

Included with this soil in mapping, and making up as much as 20 percent of the map unit, are small areas of the well drained Esmond and Maddock soils and the moderately well drained Hecla soil. The Esmond soil has a loam surface layer. The Maddock and Hecla soils have loamy fine sand and fine sand underlying material. The Esmond soil is on tops of some knolls and ridges. The Maddock soil is in the same landscape position as the

Dickey soil. The Hecla soil is in some swales and drain-aways.

This soil has rapid permeability in the upper part and moderately slow permeability in the lower part. Available water capacity is moderate, and runoff is medium. Susceptibility to soil blowing is high and to water erosion is moderate.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is fair for range, wind-breaks, and for most engineering uses. The potential is good for recreational uses, poor for crops, and very poor for wetland habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. When the soil is tilled, the main management concerns are low available water capacity, and control of soil blowing and water erosion. High stubble, intensive use of field windbreaks, annual buffer strips, and stubble mulching help to alleviate the low available water capacity and to control soil blowing. Using crop residue and planting grassed waterways where necessary help control water erosion.

Using this soil for pastureland or rangeland helps control erosion. The main management concerns are conserving soil moisture and overgrazing. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing some climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IVe.

34—Embden-Heimdal complex, 1 to 3 percent slopes. This map unit consists of deep, nearly level soils on glacial uplands. The moderately well drained Embden soil is in swales and on the lower side slopes and is 40 to 60 percent of the map unit. The well drained Heimdal soil is on rises and is 20 to 40 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 150 acres.

Typically, the Embden soil has a surface layer of black fine sandy loam about 12 inches thick. The subsoil, from 12 to 34 inches, is fine sandy loam. It is very dark grayish brown in the upper part and dark brown in the lower part. The underlying material, from 34 to 60 inches, is brown loamy fine sand. In places the surface

layer is loam. In other places there are more pebbles than normal throughout the soil.

Typically, the Heimdal soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 19 inches, is very dark grayish brown loam in the upper part and dark brown or brown loam in the lower part. The underlying material, from 19 to 60 inches, is grayish brown loam in the upper part, yellowish brown loam in the middle part, and yellowish brown sandy loam in the lower part. In places, the surface layer is sandy loam. In other places, usually on tops of rises, the surface layer is thinner and moderately eroded. A few rises are slightly stony.

Included with these soils in mapping, and making up 10 to 20 percent of the map unit, are small areas of the well drained Dickey soil, the moderately well drained Towner soil, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Dickey and Towner soils have more sand in the subsoil and surface layer and are in sandier areas of the side slopes and swales. The Parnell and Tonka soils are in deep depressions.

Permeability in the Embden soil is moderately rapid, available water capacity is moderate, and runoff is slow. Permeability in the Heimdal soil is moderate, available water capacity is high, and runoff is slow. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, wind-breaks, and recreational uses. The potential is fair for most engineering uses and is poor for wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. Control of soil blowing is the main management concern. Intensive use of field wind-breaks, annual buffer strips, and stubble mulching can alleviate this limitation.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the Embden soil. Nearly all climatically adapted species have the potential to grow well on the Heimdal soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates on the Embden soil. Wetness is a limitation for buildings on the Embden soil that can be minimized by foundation drainage or by locating structures on the higher lying Heimdal soil. Seepage is a limitation for sewage lagoons on the Heimdal soil and

can be overcome by special treatment to seal the bottom of the lagoon. Alternate sites are needed for sewage lagoons on the Embden soil. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

34B—Embden-Heimdal complex, 3 to 6 percent slopes. This map unit consists of deep, gently sloping soils on glacial uplands. The moderately well drained Embden soil is in swales and on the lower side slopes and is 35 to 55 percent of the map unit. The well drained Heimdal soil is on knolls, ridges, and upper side slopes and is 25 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 250 acres.

Typically, the Embden soil has a surface layer of black fine sandy loam about 12 inches thick. The subsoil, from 12 to 34 inches, is very dark grayish brown fine sandy loam in the upper part and dark brown fine sandy loam in the lower part. The underlying material, from 34 to 60 inches, is brown loamy fine sand. In places, the surface layer is loam. In other places, there are more pebbles than typical throughout the soil.

Typically, the Heimdal soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 19 inches, is very dark grayish brown loam in the upper part and dark brown or brown loam in the lower part. The underlying material, from 19 to 60 inches, is grayish brown loam in the upper part, yellowish brown loam in the middle part, and yellowish brown sandy clay loam in the lower part. In places the surface layer is fine sandy loam, and there is more fine sand than typical in the subsoil and underlying material. In other places, generally on the tops of knolls and ridges, the surface layer is thinner and moderately eroded. A few knolls and ridges are slightly stony.

Included with these soils in mapping, and making up 10 to 20 percent of the map unit, are small areas of the well drained Dickey soil, the moderately well drained Towner soil, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Dickey and Towner soils have more sand in the subsoil and surface layers and are in the sandier areas of side slopes and swales. The Parnell and Tonka soils are in deep depressions.

Permeability in the Embden soil is moderately rapid, available water capacity is moderate, and runoff is slow or moderate. Permeability in the Heimdal soil is moderate, available water capacity is high, and runoff is slow or medium. Susceptibility to soil blowing is high and to water erosion is low or moderate.

Most areas of these soils are used for cultivated crops. The potential is good for range, windbreaks, and recreational uses. The potential is very poor for wetland wildlife and is fair for crops and most engineering uses.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. Control of soil blowing is the main

management concern. This limitation can be alleviated by the intensive use of field windbreaks, annual buffer strips, and stubble mulching.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well in the Embden soil. Nearly all climatically adapted species have the potential to grow well on the Heimdal soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates on the Embden soil. Wetness is a limitation for buildings on the Embden soil and can be minimized by installing foundation drainage or by locating structures on the higher lying Heimdal soil. Sewage lagoons on the Heimdal soil can be treated for seepage by sealing the bottom of the lagoon. Alternate sites are needed for sewage lagoons on the Embden soil. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

34C—Embden-Heimdal complex, 6 to 9 percent slopes. This map unit consists of deep, gently rolling soils on sand mantled glacial moraines. The moderately well drained Embden soil is in swales and on the lower side slopes, and is 35 to 45 percent of the map unit. The well drained Heimdal soil is on knolls, ridges, and upper side slopes and is 35 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 125 acres.

Typically, the Embden soil has a surface layer of black fine sandy loam about 12 inches thick. The subsoil, from 12 to 34 inches, is very dark grayish brown fine sandy loam in the upper part and dark brown fine sandy loam in the lower part. The underlying material, from 34 to 60 inches, is brown loamy fine sand. In places, the surface layer is loam. In other places, there are more pebbles than typical throughout the soil.

Typically, the Heimdal soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 19 inches, is very dark grayish brown loam in the upper part and dark brown or brown loam in the lower part. The underlying material, from 19 to 60 inches, is grayish brown loam in the upper part, yellowish brown loam in the middle part, and yellowish brown sandy clay loam in the lower part. In places, the surface layer is fine sandy loam, and there is more fine sand than typical in the

subsoil and underlying material. In other places, generally on the tops of knolls and ridges, the surface layer is thinner and moderately eroded. A few knolls and ridges are slightly stony.

Included with these soils in mapping, and making up 15 to 20 percent of the map unit, are small areas of the well drained Dickey soil, the moderately well drained Towner soil, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Dickey and Towner soils have more sand in the subsoil and surface layer and are in the sandier areas of the side slopes and swales. The Parnell and Tonka soils are in deep depressions.

In the Embden soil, permeability is moderately rapid, available water capacity is moderate, and runoff is medium or rapid. In the Heimdal soil, permeability is moderate, available water capacity is high, and runoff is medium or rapid. Susceptibility to soil blowing is high and to water erosion is moderate or high.

Most areas of these soils are used for cultivated crops, hay, and pasture. The potential is fair for crops, windbreaks, and most engineering uses. The potential is good for range and recreational uses, and is very poor for wetland wildlife habitat.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. When these soils are tilled, the main management concerns are control of soil blowing and water erosion. Intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate the soil blowing limitation. Use of crop residue and planting grassed waterways where necessary help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Embden soil is suited to trees and shrubs in windbreaks and environmental plantings. Some climatically adapted species have the potential to grow well. The Heimdal soil is well suited to trees and shrubs in windbreaks and environmental plantings. Nearly all climatically adapted species have the potential to grow well. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates on the Embden soil. The wetness limitation for buildings on the Embden soil can be minimized by foundation drainage or by locating structures on the higher lying Heimdal soil. Alternate sites are needed for sewage lagoons. These soils generally are not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIc.

41—Overly silty clay loam, 1 to 3 percent slopes.

This deep, nearly level, moderately well drained soil is on glacial lake plains. Individual areas of this map unit are 5 to 160 acres.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsoil, from 10 to 27 inches, is silty clay loam. It is black in the upper part, very dark gray in the middle part, and very dark grayish brown in the lower part. The underlying material, from 27 to 60 inches, is silty clay loam. It is light brownish gray in the upper part and olive in the lower part. In places the surface layer is silt loam or silty clay. In other places, the underlying material is clay loam.

Included with this soil in mapping, and making up as much as 10 percent of the map unit, are small areas of the somewhat poorly drained Bearden soils having lime accumulation layers within a depth of 16 inches of the surface. They are in some of the deeper swales.

This soil has moderately slow permeability. Available water capacity is high, and runoff is slow. Susceptibility to soil blowing and water erosion is low.

Most areas of this soil are used for cultivated crops. The potential is good for crops, range, and windbreaks. The potential is poor for wetland wildlife habitat and is fair for most engineering and recreational uses.

This soil is well suited to wheat, oats, barley, flax, and grass-legume hay. Use of crop residue helps maintain good soil tilth.

This soil is well suited to pastureland or rangeland. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. The shrink-swell limitation for buildings can be overcome by reinforcing foundations and basement walls. This soil is poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIc.

42—Gardena silt loam, 1 to 3 percent slopes. This deep, nearly level, moderately well drained soil is on glacial lake plains and in small lake basins on glacial uplands. Individual areas of this map unit are 5 to 300 acres.

Typically, the surface layer is black silt loam about 15 inches thick. The subsoil, from 15 to 21 inches, is very dark grayish brown silt loam. The underlying material,

from 21 to 60 inches, is light olive brown silt loam in the upper and middle parts and olive silt loam in the lower part. In places, the surface layer is loam or very fine sandy loam.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the poorly drained Borup soil and the somewhat poorly drained Glyndon soil. The Borup and Glyndon soils have layers of lime accumulation within a depth of 16 inches of the surface, and are in swales.

This soil has moderate permeability. Available water capacity is high or very high, and runoff is slow. Susceptibility to soil blowing is moderate and to water erosion is low.

Most areas of this soil are used for cultivated crops. The potential is good for crops, range, windbreaks, and for most engineering and recreational uses. The potential is poor for wetland wildlife habitat.

This soil is well suited to wheat, oats, barley, flax, and grass-legume hay. Control of soil blowing is the main management concern. The use of field windbreaks, annual buffer strips, and stubble mulching helps alleviate this limitation.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is well suited to sanitary facilities and buildings. Wetness is a limitation for buildings and can be minimized by foundation drainage. Sewage lagoons can be treated for seepage by sealing the bottom of the lagoon. This soil is poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

42B—Gardena-Eckman silt loams, 3 to 6 percent slopes. This map unit consists of deep, gently sloping soils on glacial lake plains and in small lake basins on glacial uplands. The moderately well drained Gardena soil is in swales and on concave lower side slopes, and is 50 to 60 percent of the map unit. The well drained Eckman soil is on convex side slopes, and is 40 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 300 acres.

Typically, the Gardena soil has a surface layer of black silt loam about 15 inches thick. The subsoil, from 15 to 21 inches, is very dark grayish brown silt loam. The underlying material, from 21 to 60 inches, is light olive

brown silt loam in the upper and middle parts and olive silt loam in the lower part. In places, the surface layer is loam or very fine sandy loam.

Typically, the Eckman soil has a surface layer of black silt loam about 11 inches thick. The subsoil, from 11 to 26 inches, is very dark grayish brown silt loam in the upper part and dark grayish brown silt loam in the middle and lower parts. The underlying material, from 26 to 60 inches, is light olive brown silt loam. In places, the surface layer is loam or very fine sandy loam. In other places, generally on light colored knolls, the surface layer is thinner, and there is no subsoil.

Included with these soils in mapping, and making up as much as 10 percent of the map unit are small areas of the somewhat poorly drained Glyndon soil. This soil has layers of lime accumulation within a depth of 16 inches and is in some deeper swales.

The soils in this map unit have moderate permeability. Available water capacity is high or very high for the Gardena soil and high for the Eckman soil. Runoff is medium. Susceptibility to soil blowing and water erosion is moderate.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, windbreaks, and for most engineering and recreational uses. The potential is very poor for wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are control of soil blowing and water erosion. Field windbreaks, annual buffer strips, and stubble mulching help to alleviate soil blowing. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the Gardena soil. Nearly all climatically adapted species have the potential to grow well on the Eckman soils. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are well suited to sanitary facilities and buildings. Wetness is a limitation for buildings on the Gardena soil and can be minimized by foundation drainage or by locating structures on the higher lying Eckman soil. Sewage lagoons can be treated for seepage by sealing the bottom of the lagoon. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

43C—Eckman-Zell silt loams, 6 to 9 percent slopes. This map unit consists of deep, moderately slop-

ing, well drained soils on glacial lake plains and in small lake basins on glacial uplands. The Eckman soil is on side slopes and is 40 to 50 percent of the map unit. The Zell soil is on knolls and ridges and is 35 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 100 acres.

Typically, the Eckman soil has a surface layer of black silt loam about 11 inches thick. The subsoil, from 11 to 26 inches, is very dark grayish brown silt loam in the upper part and dark grayish brown silt loam in the middle and lower parts. The underlying material, from 26 to 60 inches, is light olive brown silt loam. In places, the surface layer is loam or very fine sandy loam. In other places, the slopes are strongly sloping.

Typically, the Zell soil has a surface layer of very dark gray silt loam about 8 inches thick. The next layer, from 8 to 13 inches, is very dark grayish brown silt loam. The underlying material, from 13 to 60 inches, is grayish brown silt loam. In places, the surface layer is loam or very fine sandy loam. In other places, generally on higher knolls and ridges, the surface layer is thinner and moderately eroded, and in places the slopes are strongly sloping.

Included with these soils in mapping, and making up 15 to 20 percent of the map unit, are small areas of the moderately well drained Gardena soil and the somewhat poorly drained Glyndon soil. The Gardena soil has a darker colored subsoil and surface layer, and is in swales and on lower side slopes. The Glyndon soil has layers of lime accumulation within a depth of 16 inches of the surface and is in some deeper swales.

These soils have moderate permeability. Available water capacity is high, and runoff is rapid. Susceptibility to soil blowing is moderate and to water erosion is high.

Most areas of these soils are used for cultivated crops, hay, and pasture. The potential is good for range and for most engineering and recreational uses. The potential is fair for crops and windbreaks and is very poor for wetland wildlife habitat.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. If these soils are tilled, the main management concerns are controlling soil blowing and water erosion. Field windbreaks, annual buffer strips, and stubble mulching help alleviate soil blowing. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Eckman soil is well suited to trees and shrubs in windbreaks and environmental plantings. Nearly all climatically adapted species have the potential to grow well. The Zell soil is poorly suited to trees and shrubs in

windbreaks and environmental plantings, but is suited to plantings for wildlife habitat, recreation, and beautification where survival, growth, and vigor are not required or expected to be optimum. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are well suited to sanitary facilities and buildings. Alternate sites are needed for sewage lagoons. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

44—Glyndon silt loam. This deep, level, somewhat poorly drained soil is on glacial lake plains and in small lake basins on glacial uplands. Individual areas of this map unit are 5 to 75 acres.

Typically, the surface layer is black silt loam in the upper part, very dark gray silt loam in the lower part, and 14 inches thick. The underlying material, from 14 to 29 inches, is light brownish gray silt loam. The underlying material, from 29 to 60 inches, is light yellowish brown very fine sandy loam in the upper part and multicolored stratified silt loam and loamy very fine sand in the lower part. In places, the surface layer is loam.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the poorly drained Borup and Tonka soils and the moderately well drained Gardena soil. The Borup and Tonka soils are more poorly drained, and the Gardena soil has no layers of lime accumulation within a depth of 16 inches of the surface. The Borup soil is in swales, the Tonka soil is in depressions, and the Gardena soil is on higher positions on the landscape.

Permeability is moderate in the upper part of the profile and rapid in the lower part. Available water capacity is high, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. Susceptibility to soil blowing is high.

Most areas of this soil are used for cultivated crops. The potential is good for crops, range, windbreaks, and recreational uses. The potential is fair for most engineering uses and wetland wildlife habitat.

This soil is well suited to wheat, oats, barley, flax, and grass-legume hay. The main management concern is control of soil blowing. Intensive use of field windbreaks, annual buffer strips, and stubble mulching help control soil blowing.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and

weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is suited to sanitary facilities and buildings. Wetness is a limitation for buildings and can be minimized by foundation drainage. Alternate sites are needed for sewage lagoons. This soil is suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

45—Bearden silt loam. This deep, level, somewhat poorly drained soil is on glacial lake plains. Individual areas are 5 to 250 acres.

Typically, the surface layer is black silt loam about 10 inches thick. The next layer, from 10 to 14 inches, is very dark gray light silty clay loam. The underlying material, from 14 to 23 inches, is dark grayish brown silty clay loam in the upper part, and from 23 to 60 inches it is light olive brown silty clay loam in the upper part, light olive brown silt loam in the middle part, and light olive brown loam in the lower part. In places, the underlying material is clay loam.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the poorly drained and very poorly drained Colvin soil in the deeper parts of swales.

This soil has moderately slow permeability. Available water capacity is high, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. Susceptibility to soil blowing is high.

Most areas of this soil are used for cultivated crops. The potential is good for crops, windbreaks, and range. The potential is poor for most engineering uses and is fair for most recreational uses and wetland wildlife habitat.

This soil is well suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, control of soil blowing is the main management concern. Intensive use of field windbreaks, stripcropping, and annual buffer strips help control soil blowing.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is poorly suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Wetness is a limitation for build-

ings that can be minimized by foundation drains. The shrink-swell potential is a limitation for buildings that can be overcome by reinforcing basement walls and foundations. This soil is suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

46—Borup silt loam. This deep, level, poorly drained soil is on glacial lake plains and, less commonly, on stream bottom lands. Individual areas of this map unit are 5 to 100 acres.

Typically, the surface layer is silt loam about 12 inches thick. It is black in the upper part and very dark gray in the lower part. The underlying material, from 12 to 30 inches, is dark gray and gray silt loam. The underlying material, from 30 to 60 inches, is grayish brown silt loam in the upper part and olive brown very fine sandy loam in the lower part. In places the soil is moderately saline.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the very poorly drained Colvin soil, the somewhat poorly drained Divide and Glyndon soils, and the poorly drained and very poorly drained Marysland soil. The Colvin soil contains more clay. The Divide and Marysland soils have sand and gravel underlying material. The Glyndon soil is better drained. The Colvin soil and the very poorly drained Marysland soil are on the same landscape position as this Borup soil. The Divide and Glyndon soils are on slightly higher swells.

This Borup soil has moderately rapid permeability. Available water capacity is high, and runoff is slow. Wetness and some surface ponding occur in spring and after heavy rainy periods. Susceptibility to soil blowing is high.

Most areas of this soil are used for pasture and hayland. The potential is good for range, crops, windbreaks, and wetland wildlife habitat. The potential is poor for recreational uses and most engineering uses.

Where drained, this soil is well suited to wheat, barley, oats, grass-legume hay, and flax. Undrained areas are best suited to native range and hay. Drainage can increase the suitability for crops, however, adequate outlets are difficult to locate. If this soil is tilled, the main management concerns are wetness and soil blowing. Proper maintenance of surface drains helps reduce the wetness. Intensive use of field windbreaks, stripcropping, and annual buffer strips can control soil blowing.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

Where drained, this soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is poorly suited to sanitary facilities and buildings. Wetness is a severe limitation that can be overcome in part by drainage; however, adequate outlets are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass IIw.

47—Fossum fine sandy loam. This deep, level, poorly drained soil is on sandy glacial lake and outwash plains. Individual areas of this map unit are 5 to 100 acres.

Typically, the surface layer is black fine sandy loam in the upper part, very dark gray fine sandy loam in the middle and lower parts, and about 19 inches thick. The underlying material, from 19 to 60 inches, is dark grayish brown loamy fine sand in the upper part, grayish brown loamy fine sand in the middle part, and olive loamy fine sand in the lower part. In places, layers of lime accumulation are within a depth of 16 inches of the surface. In other places the surface layer is loam or sandy loam.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the moderately well drained Hecla soil on the higher swells.

This Fossum soil has rapid permeability. Available water capacity is low or moderate, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness. Susceptibility to soil blowing is high.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is poor for crops and for most engineering and recreational uses. The potential is fair for range and is good for windbreaks and wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are wetness and control of soil blowing. Adequate drainage outlets are often difficult to locate. Maintaining surface drains, and intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

If drained, this soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings. Undrained areas are not suited to these uses.

This soil is poorly suited to sanitary facilities and buildings. Wetness and flooding are severe limitations that can be overcome in part by drainage; however, adequate

outlets are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass IVw.

50B—Great Bend silt loam, 3 to 6 percent slopes.

This deep, gently sloping, well drained soil is on glacial lake plains and in small lake basins on glacial uplands. Individual areas of this map unit are 5 to 175 acres.

Typically the surface layer is black silt loam about 9 inches thick. The subsoil, from 9 to 15 inches, is very dark grayish brown silty clay loam. The underlying material, from 15 to 60 inches, is olive brown silty clay loam in the upper part, grayish brown and light olive brown silt loam in the middle part, and light olive brown silt loam in the lower part. In places, the surface layer is silty clay loam or silty clay.

Included with this soil in mapping, and making up 10 to 20 percent of the map unit, are small areas of the somewhat poorly drained Bearden soil, the poorly drained Colvin soil, and the moderately well drained Overly soil. The Bearden and Colvin soils have layers of lime accumulation within a depth of 16 inches of the surface and are in some of the deeper swales. The Overly soil has a thicker subsoil and surface layer and is in swales and on the lower side slopes.

This soil has moderate permeability. Available water capacity is high, and runoff is medium. Susceptibility to soil blowing is low and to water erosion is moderate.

Most areas of this soil are used for cultivated crops. The potential is good for crops, range, windbreaks, and recreational uses. The potential is fair for most engineering uses and is very poor for wetland wildlife habitat.

This soil is well suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are maintaining good soil tilth and controlling soil blowing. Use of crop residue and planting of grassed waterways where necessary can help control water erosion.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing nearly all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is suited to sanitary facilities and buildings. The moderately slow permeability for septic tanks can be overcome by increasing the size of the absorption field. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. Sewage lagoons can be treated for seepage by sealing

the bottom of the lagoon. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

52B—Embden-Egeland fine sandy loams, 1 to 6 percent slopes. This map unit consists of deep, nearly level and gently sloping soils on glacial outwash plains. The moderately well drained Embden soil is in swales and on lower side slopes, and is 40 to 55 percent of the map unit. The well drained Egeland soil is on rises and upper side slopes, and is 30 to 40 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 50 to 300 acres.

Typically, the Embden soil has a surface layer of black fine sandy loam about 12 inches thick. The subsoil, from 12 to 34 inches, is very dark grayish brown fine sandy loam in the upper part and dark brown fine sandy loam in the lower part. The underlying material, from 34 to 60 inches, is brown loamy fine sand. In places the surface layer is sandy loam and the underlying material below 40 inches is loam. In other places the surface layer is moderately eroded, or there is no subsoil and the underlying material is fine sand.

Typically, the Egeland soil has a surface layer of black fine sandy loam about 7 inches thick. The subsoil, from 7 to 31 inches, is very dark grayish brown fine sandy loam in the upper part, olive brown fine sandy loam in the middle part, and light olive fine sandy loam in the lower part. The underlying material, from 31 to 60 inches, is grayish brown loamy fine sand in the upper part and dark grayish brown loamy fine sand in the lower part. In places the surface layer is sandy loam and the underlying material below 40 inches is loam. In other places, the surface layer is moderately eroded, and in places the subsoil is loamy fine sand and the underlying material is fine sand.

These soils have moderately rapid permeability. Available water capacity is moderate, and runoff is slow. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of these soils are used for cultivated crops. The potential is good for range, windbreaks, and for most engineering and recreational uses. The potential is fair for crops and is very poor for wetland wildlife habitat.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are low available water capacity and control of soil blowing. High stubble, intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using these soils for pastureland or rangeland helps control erosion. The main management concerns are conserving soil moisture and overgrazing. Proper stock-

ing rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Embden soil is well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well. The Egeland soil is suited to trees and shrubs in windbreaks and environmental plantings. Some climatically adapted species have the potential to grow well. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Wetness is a limitation for buildings on the Embden soil and can be minimized by foundation drainage or by locating structures on the higher lying Egeland soil. Alternate sites are needed for sewage lagoons. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

53—Hecla fine sandy loam, 1 to 3 percent slopes. This deep, nearly level, moderately well drained soil is on sandy plains. Individual areas of this map unit are 5 to 300 acres.

Typically, the surface layer is black fine sandy loam in the upper part and very dark grayish brown fine sandy loam in the lower part, and is about 26 inches thick. The underlying material, from 26 to 60 inches, is brown fine sand in the middle and lower parts. In places the surface layer is sandy loam or loamy fine sand, in other places the surface layer is moderately eroded. In places the subsoil is fine sandy loam, and the underlying material is loamy fine sand.

Included with this soil in mapping, and making up 15 to 20 percent of the map unit, are small areas of the somewhat excessively drained Arvilla soil, the well drained Maddock soil, and the poorly drained Fossum soil. The Arvilla soil has sand and gravel in the underlying material and the Maddock soil has a thinner surface layer; they are on higher positions on rises. The Fossum soil is more poorly drained and is in lower positions in swales.

This Hecla soil has rapid permeability. Available water capacity is low or moderate, and runoff is slow. Susceptibility to soil blowing is high.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is good for range, windbreaks, and recreational uses. The potential is fair for crops and for most engineering uses and is poor for wetland wildlife habitat.

This soil is suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are the low available water capacity and control of soil blowing. High stubble, intensive use of field windbreaks, annual buffer strips, and stubble mulching help alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Wetness is a limitation for buildings that can be minimized by foundation drainage. Alternate sites are needed for sewage lagoons. This soil is poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

54B—Hecla-Maddock fine sandy loams, 3 to 6 percent slopes. This map unit consists of deep, gently sloping soils on sandy plains. The moderately well drained Hecla soil is in swales and on the concave lower side slopes and is 45 to 65 percent of the map unit. The well drained Maddock soil is on knolls and upper side slopes and is 25 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 150 acres.

Typically, the surface layer of the Hecla soil is black fine sandy loam in the upper part, very dark grayish brown fine sandy loam in the lower part, and about 26 inches thick. The underlying material, from 26 to 60 inches, is brown fine sand in the upper part and light olive brown fine sand in the middle and lower parts. In some places the surface layer is sandy loam or loamy fine sand, or it is moderately eroded. In places, the subsoil is fine sandy loam, and the underlying material is loamy fine sand.

Typically, the Maddock soil has a surface layer of very dark gray fine sandy loam about 12 inches thick. The subsoil, from 12 to 21 inches, is dark brown loamy fine sand. The underlying material, from 21 to 60 inches, is dark brown fine sand in the upper part and dark grayish brown fine sand in the lower part. In places the surface layer is sandy loam or loamy fine sand. In other places, generally on tops of knolls, the surface layer is thinner and moderately eroded. In places the subsoil is fine sandy loam and the underlying material is loamy fine sand.

Included with these soils in mapping, and making up as much as 10 percent of the map unit, are small areas of the poorly drained Fossum soil in lower positions in the swales.

The soils in this map unit have rapid permeability. Available water capacity is low or moderate for the Hecla soil and low for the Maddock soil, and runoff is slow. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of these soils are used for cultivated crops, hay, and pasture. The potential is good for range, windbreaks, and recreational uses. The potential is fair for crops and for most engineering uses and is poor for wetland wildlife habitat.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. When these soils are tilled, the main management concerns are low available water capacity and control of soil blowing. High stubble, intensive use of field windbreaks, annual buffer strips, and stubble mulching help alleviate these limitations.

Using these soils for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Hecla soil is well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well.

The Maddock soil is suited to trees and shrubs in windbreaks and environmental plantings. Some climatically adapted species have the potential to grow well. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Wetness is a limitation for buildings on the Hecla soil and can be minimized by foundation drainage or by locating structures on the higher lying Maddock soil. Alternate sites are needed for sewage lagoons. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

58—Hecla-Maddock loamy fine sands, 1 to 3 percent slopes. This map unit consists of deep, nearly level soils on sandy plains. The moderately well drained Hecla soil is in swales and on the concave lower side slopes and is 50 to 70 percent of the map unit. The well drained Maddock soil is on rises and is 25 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 150 acres.

Typically, the surface layer of the Hecla soil is black in the upper part, very dark grayish brown loamy fine sand in the lower part, and about 26 inches thick. The underlying material, from 26 to 60 inches, is brown fine sand in the upper part and light olive brown fine sand in the

middle and lower parts. In places, the surface layer is loamy sand, and in other places it is moderately eroded.

Typically, the Maddock soil has a surface layer of very dark gray loamy fine sand about 12 inches thick. The subsoil, from 12 to 21 inches, is dark brown loamy fine sand. The underlying material, from 21 to 60 inches, is dark brown fine sand in the upper part and dark grayish brown fine sand in the lower part. In places, the surface layer is loamy sand. In other places, generally on tops of rises, the surface layer is thinner and moderately eroded with a few small blowout spots.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the well drained Dickey soil, the moderately well drained Towner soil, and the poorly drained Fossum soil. The Dickey and Towner soils have fine sandy loam surface layers and loam underlying material. The Dickey soil is on the same landscape position as the Maddock soil, and the Towner soil is in some swales. The Fossum soil is in lower positions in the swales.

Permeability is rapid, available water capacity is low or moderate for the Hecla soil and low for the Maddock soil, and runoff is slow. Susceptibility to soil blowing is very high.

Most areas of these soils are used for cultivated crops, hay, and pasture. The potential is fair for range, windbreaks, and for most engineering and recreational uses. The potential is poor for crops and wetland wildlife habitat.

These soils are poorly suited to wheat, oats, barley, flax, and grass-legume hay. If these soils are tilled, the main management concerns are low available water capacity and control of soil blowing. High stubble, intensive use of field windbreaks, annual buffer strips, and stubble mulching help alleviate these limitations.

Using these soils for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Hecla soil is well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the Hecla soil.

The Maddock soil is suited to trees and shrubs in windbreaks and environmental plantings. Some climatically adapted species have the potential to grow well on the Maddock soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Wetness is a limitation for buildings on the Hecla soil and can be minimized by foundation drainage or by locating structures on the higher lying

Maddock soil. Alternate sites are needed for sewage lagoons. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IVe.

59B—Maddock-Hecla loamy fine sands, 3 to 6 percent slopes. This map unit consists of deep, gently sloping soils on sandy plains. The well drained Maddock soil is on knolls and upper side slopes and is 45 to 65 percent of the map unit. The moderately well drained Hecla soil is in swales and on concave lower side slopes and is 25 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 300 acres.

Typically, the Maddock soil has a surface layer of very dark gray loamy fine sand about 12 inches thick. The subsoil, from 12 to 21 inches, is dark brown loamy fine sand. The underlying material, from 21 to 60 inches, is dark brown fine sand in the upper part and dark grayish brown fine sand in the lower part. In places, the surface layer is loamy sand. In other places, generally on the tops of knolls, the surface layer is thinner and somewhat eroded with a few small blowout spots.

Typically, the surface layer of the Hecla soil is black loamy fine sand in the upper part and very dark grayish brown loamy fine sand in the lower part, and is about 26 inches thick. The underlying material, from 26 to 60 inches, is brown fine sand in the upper part and light olive brown fine sand in the middle and lower parts. In some places the surface layer is loamy sand, or it is moderately eroded.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the well drained Dickey soil and the poorly drained Fossum soil. The Dickey soil has a fine sandy loam surface layer and loam underlying material and is on the same landscape position as the Maddock soil. The Fossum soil is in lower positions in the swales.

Permeability is rapid, available water capacity is low for the Maddock soil and low or moderate for the Hecla soil, and runoff is slow. Susceptibility to soil blowing is very high and to water erosion is low.

Most areas of these soils are used for cultivated crops, hay, and pasture. The potential is fair for range, windbreaks, and recreational uses. The potential is good for most engineering uses, poor for crops, and very poor for wetland wildlife habitat.

These soils are poorly suited to wheat, oats, barley, flax, and grass-legume hay. If the soils are tilled, the main management concerns are low available water capacity and control of soil blowing. High stubble, intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using these soils for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking

rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Maddock soil is suited to trees and shrubs in windbreaks and environmental plantings. Some climatically adapted species have the potential to grow well on the Maddock soil.

The Hecla soil is well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the Hecla soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Wetness is a limitation for buildings on the Hecla soil and can be minimized by foundation drainage or by locating structures on the higher lying Maddock soil. Alternate sites are needed for sewage lagoons. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IVe.

59D—Maddock loamy fine sand, 6 to 15 percent slopes. This deep, moderately sloping and strongly sloping, well drained soil is on sandy plains and sand mantled moraines. Individual areas of this map unit are 5 to 150 acres.

Typically, the surface layer is very dark gray loamy fine sand about 12 inches thick. The subsoil, from 12 to 21 inches, is dark brown loamy fine sand. The underlying material, from 21 to 60 inches, is dark brown fine sand in the upper part and dark grayish brown fine sand in the lower part. In places the surface layer is loamy sand or fine sandy loam. In other places, generally on tops of knolls and ridges, the surface layer is thinner and moderately eroded with a few small blowout spots. In addition, the tops of knolls and ridges are slightly stony or gravelly in places.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the well drained Dickey soil and the moderately well drained Hecla soil. The Dickey soil has a fine sandy loam surface layer and loam underlying material and is on knolls and ridges. The Hecla soil has a thicker surface layer and is in swales.

This Maddock soil has rapid permeability. Available water capacity is low, and runoff is medium or rapid. Susceptibility to soil blowing is very high and to water erosion is moderate or high.

Most areas of this soil are used for hay and range. The potential is fair for range and for most engineering and recreational uses. The potential is poor for crops and windbreaks and is very poor for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of slope, the high hazard of soil blowing, and the low available water capacity.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Slope is a limitation for buildings that can be overcome by cut and fill operations. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass VIe.

61—Renshaw loam, 1 to 3 percent slopes. This deep, nearly level, somewhat excessively drained soil is on glacial outwash plains and stream terraces. The soil is shallow over sand and gravel. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the surface layer is black loam about 7 inches thick. The subsoil, from 7 to 16 inches, is very dark grayish brown loam in the upper part and dark brown loam in the lower part. The underlying material, from 16 to 60 inches, is dark brown and dark gray coarse sand gravel. In places the surface layer and subsoil are sandy loam. In other places the soil is excessively drained, the surface layer is less than 7 inches thick, and the depth to sand and gravel ranges from 9 to 16 inches.

Included with this soil in mapping, and making up 10 to 20 percent of the map unit, are small areas of the moderately well drained Fordville soil. This soil is moderately deep over sand and gravel and is in the swales.

This Renshaw soil has rapid permeability. Available water capacity is low, and runoff is slow. Susceptibility to soil blowing and water erosion is low.

Most areas of this soil are used for cultivated crops. The potential is good for most engineering and recreational uses and is poor for crops and windbreaks. The potential is fair for range and is very poor for wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. Low available water capacity is the main management concern. Stubble mulching and high stubble help alleviate this limitation.

This soil is suited to pastureland or rangeland. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing a few climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating groundwater supplies because of high seepage rates. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

61B—Renshaw loam, 3 to 6 percent slopes. This deep, gently sloping, somewhat excessively drained soil is on glacial outwash plains and stream terraces. The soil is shallow over sand and gravel. Individual areas of this map unit are 5 to 250 acres.

Typically, the surface layer is black loam about 7 inches thick. The subsoil, from 7 to 16 inches, is very dark grayish brown loam in the upper part and dark brown loam in the lower part. The underlying material, from 16 to 60 inches, is dark brown and dark gray coarse sand and gravel. In places the surface layer and subsoil are sandy loam. In other places the soil is excessively drained, the surface layer is less than 7 inches thick, and the depth to sand and gravel ranges from 9 to 16 inches. In places the slopes are moderate.

Included with this soil in mapping, and making up as much as 20 percent of the map unit are small areas of the moderately well drained Fordville soil. This soil is moderately deep over sand and gravel and is in swales.

This Renshaw soil has rapid permeability. Available water capacity is low, and runoff is medium. Susceptibility to soil blowing is low and to water erosion is moderate.

Most areas of this soil are used for cultivated crops. The potential is good for most engineering and recreational uses and is poor for crops and windbreaks. The potential is fair for range and is very poor for wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are low available water capacity and control of water erosion. Stubble mulching and high stubble help alleviate the low available water capacity. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing a few climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high

seepage rates. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

63—Brantford loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on glacial outwash plains and stream terraces. The soil is shallow over sand and gravel that is mainly shale in origin. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsoil, from 8 to 13 inches, is dark brown loam. The underlying material, from 13 to 60 inches, is dark grayish brown and is loam in the upper part, loamy coarse sand and shaly coarse sand in the middle part, and coarse sand and gravel in the lower part. In places the surface layer is moderately eroded.

Included with this soil in mapping, and making up as much as 20 percent of the map unit, are small areas of the excessively drained Coe soil and the well drained Vang soil. The Coe soil is very shallow over shaly sand and gravel and is on some higher rises. The Vang soil is moderately deep over shaly sand and gravel and is in swales.

This Brantford soil has moderate permeability in the upper part and very rapid permeability in the underlying material. Available water capacity is low, and runoff is slow. Susceptibility to soil blowing is moderate and to water erosion is low.

Most areas of this soil are used for cultivated crops. The potential is good for most engineering and recreational uses and is poor for crops and windbreaks. The potential is fair for range and is very poor for wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are low available water capacity and control of soil blowing. High stubble, use of field windbreaks, annual buffer strips, and stubble mulching help alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing a few climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIs.

63B—Brantford loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on glacial outwash plains and stream terraces. The soil is shallow over sand and gravel that is mainly shale in origin. Individual areas of this map unit are 5 to 600 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsoil, from 8 to 13 inches, is dark brown loam. The underlying material, from 13 to 60 inches, is dark grayish brown and is loam in the upper part, loamy coarse sand and shaly coarse sand in the middle part, and coarse sand and gravel in the lower part. In places the surface layer is moderately eroded.

Included with this soil in mapping, and making up as much as 20 percent of the map unit, are small areas of the excessively drained Coe soil and the well drained Vang soil. The Coe soil is very shallow over shaly sand and gravel and is on higher knolls and ridges. The Vang soil is moderately deep over shaly sand and gravel and is in swales.

This Brantford soil has moderate permeability in the upper part and very rapid permeability in the underlying material. Available water capacity is low, and runoff is medium. Susceptibility to soil blowing and to water erosion is moderate.

Most areas of this soil are used for cultivated crops. The potential is good for most engineering and recreational uses and is poor for crops and windbreaks. The potential is fair for range and is very poor for wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are low available water capacity and control of soil blowing and water erosion. High stubble, use of field windbreaks, annual buffer strips, and stubble mulching can alleviate the low available water capacity and soil blowing. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing a few climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

63C—Brantford loam, 6 to 9 percent slopes. This deep, moderately sloping, well drained soil is on glacial outwash plains and stream terraces. The soil is shallow over sand and gravel that is mainly shale in origin. Individual areas of this map unit are 5 to 200 acres.

Typically, the surface layer is black loam about 8 inches thick. The subsoil, from 8 to 13 inches, is dark brown loam. The underlying material, from 13 to 60 inches, is dark grayish brown and is loam in the upper part, loamy coarse sand and shaly coarse sand in the two middle parts, and coarse sand and gravel in the lower part. In places the surface layer is sandy loam, and in other places it is moderately eroded.

Included with this soil in mapping, and making up as much as 20 percent of the map unit, are small areas of the excessively drained Coe soil and the well drained Vang soil. The Coe soil is very shallow over shaly sand and gravel and is on higher knolls and ridges. The Vang soil is moderately deep over shaly sand and gravel and is in swales.

This Brantford soil has moderate permeability in the upper part and very rapid permeability in the underlying material. Available water capacity is low, and runoff is rapid. Susceptibility to soil blowing is moderate and to water erosion is high.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is good for most engineering and recreational uses and is poor for crops and windbreaks. The potential is fair for range and is very poor for wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are low available water capacity and control of soil blowing and water erosion. High stubble, use of field windbreaks, annual buffer strips, and stubble mulching can alleviate the low available water capacity and soil blowing. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing a few climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IVe.

64—Divide loam, 1 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on stream terraces and glacial outwash plains. The soil is moderately deep over sand and gravel. Individual areas of this map unit are 5 to 400 acres.

Typically, the surface layer is black loam in the upper part and very dark gray clay loam in the lower part about 10 inches thick. The underlying material, from 10 to 22 inches, is grayish brown clay loam. The underlying material, from 22 to 60 inches, is dark grayish brown and dark brown sand and gravel. In swales, the depth to sand and gravel is generally greater than 22 inches, and on rises it is less than 22 inches. In places, the depth to high lime is greater than 16 inches.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the well drained Fordville soil, the poorly drained Marysland soil, and the somewhat excessively drained Renshaw soil. The Fordville and Renshaw soils have no layers of lime accumulation within a depth of 16 inches of the surface, and are on higher rises. The more poorly drained Marysland soil is on lower positions in swales.

This Divide soil has moderate permeability in the upper part and very rapid permeability in the underlying material. Available water capacity is low or moderate, and runoff is slow. Early in spring and after unusually heavy rainy periods a temporary high water table develops, resulting in wetness. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of this soil are used for cultivated crops. The potential is fair for crops and recreational uses. The potential is good for range and windbreaks and is poor for most engineering uses and wetland wildlife habitat.

This soil is suited to wheat, oats, barley, flax, and grass-legume hay. Wetness and control of soil blowing are the main management concerns. Adequate outlets for drainage are often difficult to locate. Maintaining surface drains and intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is poorly suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Wetness is a limitation for buildings that can be minimized by foundation drainage. Alternate sites

are needed for sewage lagoons. This soil is poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIIs.

65—Vang loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on stream terraces and glacial outwash plains. The soil is moderately deep over sand and gravel that is mainly shale in origin. Individual areas of this map unit are 5 to 400 acres.

Typically, the surface layer is black loam about 17 inches thick. The subsoil, from 17 to 30 inches, is very dark brown loam in the upper part and brown and dark brown loam in the lower part. The underlying material, from 30 to 60 inches, is olive stratified shaly sand and gravel.

Included with this soil in mapping, and making up 10 to 20 percent of the map unit, are small areas of the well drained Brantford soil and the moderately well drained Gardena soil. The Brantford soil is shallow over shaly sand and gravel and is on rises. The Gardena soil has silt loam from the surface layer through the underlying material and is on the same landscape position as the Vang soil.

This Vang soil has moderate permeability in the upper part and very rapid permeability in the underlying material. Available water capacity is moderate, and runoff is slow. Susceptibility to soil blowing and to water erosion is low.

Most areas of this soil are used for cultivated crops. The potential is good for range, windbreaks, and for most engineering and recreational uses. The potential is fair for most crops and is poor for wetland wildlife habitat.

This soil is suited to wheat, oats, barley, flax, and grass-legume hay. Low available water capacity is the main management concern. Leaving high stubble and stubble mulching can alleviate this limitation.

This soil is well suited to pastureland or rangeland. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing nearly all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Alternate sites are needed for sewage lagoons. This soil is poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIs.

65B—Vang loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on stream terraces and glacial outwash plains. The soil is moderately deep over sand and gravel that is mainly shale in origin. Individual areas of this map unit are 5 to 100 acres.

Typically, the surface layer is black loam about 17 inches thick. The subsoil, from 17 to 30 inches, is very dark brown loam in the upper part and brown and dark brown loam in the lower part. The underlying material, from 30 to 60 inches, is olive stratified shaly sand and gravel.

Included with this soil in mapping, and making up 10 to 20 percent of the map unit, are small areas of the well drained Brantford soil. This soil is shallow over shaly sand and gravel and is on knolls and ridges.

This Vang soil has moderate permeability in the upper part and very rapid permeability in the underlying material. Available water capacity is moderate, and runoff is medium. Susceptibility to soil blowing is low and to water erosion is moderate.

Most areas of this soil are used for cultivated crops. The potential is good for range, windbreaks, and for most engineering and recreational uses. The potential is fair for crops and is very poor for wetland wildlife habitat.

This soil is suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are low available water capacity and control of water erosion. High stubble and stubble mulching can alleviate low available water capacity. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing nearly all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

66—Marysland loam. This deep, level, poorly drained soil is on stream terraces and glacial outwash plains. The soil is moderately deep over sand. Individual areas of this map unit are 5 to 350 acres.

Typically, the surface layer is black loam about 8 inches thick. The underlying material, from 8 to 26 inches, is dark gray clay loam and olive gray loam. The

underlying material, from 26 to 60 inches, is dark grayish brown coarse sand. In places, generally on swells, the soil is somewhat poorly drained. In other places it is moderately saline.

Included with this soil in mapping, and making up as much as 10 percent of the map unit, are small areas of the poorly drained Borup soil. This soil is on the same landscape position as the Marysland soil and does not have coarse sand in the underlying material.

This Marysland soil has moderate permeability in the upper part and rapid permeability in the underlying material. Available water capacity is moderate, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. Susceptibility to soil blowing is high.

Most areas of this soil are used for cultivated crops and range. The potential is poor for crops and for most engineering and recreational uses. The potential is fair for range and is good for windbreaks and wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are wetness and control of soil blowing. Adequate outlets for drainage water are often difficult to locate. Maintaining surface drains and intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

Where drained, this soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings. Undrained areas are unsuited to these uses.

This soil is poorly suited to sanitary facilities and buildings. Wetness is a severe limitation that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass IVw.

67—Marysland loam, wet. This deep, level, very poorly drained soil is on glacial outwash plains and in old stream channels. The soil is moderately deep over sand. Individual areas of this map unit are 5 to 100 acres.

Typically, the surface layer is black loam about 8 inches thick. The underlying material, from 8 to 26 inches, is dark gray clay loam and olive gray loam. The

underlying material, from 26 to 60 inches, is dark grayish brown coarse sand.

Included with this soil in mapping, and making up as much as 20 percent of the map unit, are small areas of the poorly drained Borup soil and the poorly drained and very poorly drained Colvin soil. These soils are in the same landscape position as the Marysland soil and do not have coarse sand in the underlying material.

This Marysland soil has moderate permeability in the upper part, and rapid permeability in the underlying material. Available water capacity is moderate, and runoff is slow. This soil is ponded early in spring and after heavy rainy periods. The water table is near the surface throughout most of the year. Susceptibility to soil blowing is high.

Most areas of this soil are used for hay, range, and wetland wildlife habitat. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. The potential is fair for range and is good for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of wetness, surface ponding, and the absence of suitable outlets.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to sanitary facilities and buildings. Wetness and flooding are severe limitations that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass Vw.

68B—Arvilla sandy loam, 1 to 6 percent slopes.

This deep, nearly level and gently sloping, somewhat excessively drained soil is on glacial outwash plains and stream terraces. The soil is moderately deep over sand and gravel. Individual areas of this map unit are 5 to 350 acres.

Typically, the surface layer is black sandy loam about 8 inches thick. The subsoil, from 8 to 15 inches, is dark brown sandy loam. The underlying material, from 15 to 60 inches, is grayish brown sandy loam in the upper part and yellowish brown coarse sand and gravel in the lower part. The depth to sand and gravel is less on some knolls and ridges and greater in some swales. In places the slopes are moderate.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the excessively drained Sioux soil. This soil has a gravelly loam and loam surface layer and is very shallow over sand and gravel. It is on higher knolls and ridges.

This soil has rapid permeability. Available water capacity is low, and runoff is slow. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is poor for crops and windbreaks and is good for most engineering and recreational uses. The potential is fair for range and is very poor for wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are low available water capacity and control of soil blowing. High stubble, intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing a few climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and the ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Alternate sites are needed for sewage lagoons. This soil is not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

70B—Binford sandy loam, 1 to 6 percent slopes.

This deep, nearly level and gently sloping, well drained and somewhat excessively drained soil is on glacial plains and stream terraces. The soil is moderately deep over sand and gravel that is mainly shale in origin. Individual areas of this map unit are 5 to 100 acres.

Typically, the surface layer is black sandy loam in the upper part, very dark gray sandy loam in the lower part, and about 9 inches thick. The subsoil, from 9 to 20 inches, is dark brown sandy loam in the upper part and dark grayish brown sandy loam in the lower part. The underlying material, from 20 to 60 inches, is grayish brown shaly sandy loam in the upper part and dark grayish brown shaly coarse loamy sand in the middle and lower parts. In places the soils are moderately sloping, and in other areas the surface layer is moderately eroded. In places the surface layer and subsoil are loam, and in other areas the depth to shaly sand and gravel ranges from 14 to 20 inches.

Included with this soil in mapping, and making up as much as 20 percent of the map unit, are small areas of the excessively drained Coe soil and the well drained Vang soil. The Coe soil is very shallow over shaly sand and gravel and is on higher knolls and ridges. The Vang soil has a loam surface layer and subsoil and is in some swales.

This Binford soil has rapid permeability. Available water capacity is low, and runoff is slow. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is poor for crops and windbreaks and is good for most engineering and recreational uses. The potential is fair for range and is very poor for wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are low available water capacity and control of soil blowing. High stubble, intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing a few climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Alternate sites are needed for sewage lagoons. This soil is not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

71—Svea-Cresbard loams, 1 to 3 percent slopes.

This map unit consists of deep, nearly level, moderately well drained soils on glacial till plains. The Svea soil is on gentle rises and in some swales and is 60 to 80 percent of the map unit. The Cresbard soil is in swales and on some rises and is 20 to 40 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 500 acres.

Typically, the Svea soil has a surface layer of black loam about 12 inches thick. The subsoil, from 12 to 22 inches, is very dark grayish brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 22 to 60 inches, is grayish brown loam. In places the soil is well drained, and the black surface layer is less than 12 inches thick.

Typically, the Cresbard soil has a surface layer of very dark gray loam about 6 inches thick. The subsurface layer, from 6 to 8 inches, is dark grayish brown loam. The subsoil, from 8 to 16 inches, is dark grayish brown dense silty clay in the upper part and very dark grayish brown dense silty clay in the lower part. The underlying material from 16 to 60 inches is olive brown clay loam in the upper part and dark grayish brown clay loam in the

lower part. In places the subsoil is denser. In some of these areas the surface layer is thinner and the soil is somewhat poorly drained.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the somewhat poorly drained Hamerly soil, the very poorly drained Parnell soil, and the poorly drained Tonka and Vallers soils. The Hamerly and Vallers soils are around the margins of deep depressions and have layers of lime accumulation within a depth of 16 inches of the surface. The Parnell and Tonka soils are in deep depressions.

Permeability in the Svea soil is slow, available water capacity is high, and runoff is slow. Permeability in the Cresbard soil is slow, available water capacity is moderate, and runoff is slow. In areas of the Cresbard soil, the surface is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing and to water erosion is low.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, and windbreaks. The potential is fair for most engineering and recreational uses and is poor for wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. Maintaining good soil tilth is the main management concern. Use of crop residue helps control this limitation.

These soils are well suited to pastureland or rangeland. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Svea soil is well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the Svea soil.

The Cresbard soil is suited to trees and shrubs in windbreaks and environmental plantings. Many climatically adapted species have the potential to grow well on the Cresbard soils. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The moderately slow or slow permeability is a limitation for septic tanks that can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings on the Svea soil and can be minimized by foundation drainage. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIIs.

71B—Svea-Cresbard loams, 3 to 6 percent slopes.

This map unit consists of deep, gently sloping, moderately well drained soils on glacial till plains and valley foot slopes. The Svea soil is on side slopes and in some swales and is 60 to 80 percent of the map unit. The Cresbard soil is in swales and on some side slopes and is 20 to 40 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 160 acres.

Typically, the Svea soil has a surface layer of black loam about 12 inches thick. The subsoil, from 12 to 22 inches, is very dark grayish brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 22 to 60 inches, is grayish brown loam. In places, generally on tops of knolls, the soil is well drained, and the black surface layer is less than 12 inches thick.

Typically, the Cresbard soil has a surface layer of very dark gray loam about 6 inches thick. The subsurface layer, from 6 to 8 inches, is dark grayish brown loam. The subsoil, from 8 to 16 inches, is dense silty clay and is dark grayish brown in the upper part and very dark grayish brown in the lower part. The underlying material, from 16 to 60 inches, is olive brown clay loam in the upper part and dark grayish brown clay loam in the lower part. In places, the subsoil is denser. In some of these areas, the surface layer is thinner and the soil is somewhat poorly drained.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the somewhat poorly drained Hamerly soil, the very poorly drained Parnell soil, and the poorly drained Tonka and Vallery soils. The Hamerly and Vallery soils are around the margins of deep depressions and have layers of lime accumulation within a depth of 16 inches. The Parnell and Tonka soils are in deep depressions.

Permeability in the Svea soil is moderately slow, available water capacity is high, and runoff is medium. Permeability in the Cresbard soil is slow, available water capacity is moderate, and runoff is medium. Areas of the Cresbard soil have a surface that is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing is low and to water erosion is moderate.

Most areas of these soils are used for cultivated crops. The potential is fair for crops and for most engineering and recreational uses. The potential is good for range and windbreaks and is very poor for wetland wildlife habitat.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are maintaining good soil tilth and controlling water erosion. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is

wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Svea soil is well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species grow well on the Svea soils.

The Cresbard soil is suited to trees and shrubs in windbreaks and environmental plantings. Many climatically adapted species have the potential to grow well on the Cresbard soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The moderately slow or slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings on the Svea soil and can be minimized by foundation drainage. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

73—Larson-Cathay loams, 1 to 3 percent slopes.

This map unit consists of deep, nearly level soils on glacial till plains. The moderately well drained and somewhat poorly drained Larson soil is in swales and on slopes and is 40 to 60 percent of the map unit. The moderately well drained Cathay soil is in swales and on side slopes and is 30 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 150 acres.

Typically, the Larson soil has a surface layer of black loam about 6 inches thick. The subsurface layer is very dark gray loam 6 to 7 inches thick. The subsoil, from 7 to 20 inches, is dense clay loam and is very dark brown in the upper part and very dark grayish brown in the middle and lower parts. The underlying material, from 20 to 60 inches, is light brownish gray clay loam in the upper part, grayish brown clay loam in the middle part, and light olive brown clay loam in the lower part. In places the slopes are gentle. In places the surface layer ranges from 3 to 6 inches thick, and the subsoil is more dense. In other places, particularly the southwestern part of the county, the surface layer is silt loam or very fine sandy loam. In parts of this area the underlying material has a higher clay content.

Typically, the Cathay soil has a surface layer of black loam about 8 inches thick. The subsurface layer is dark grayish brown loam 8 to 9 inches thick. The subsoil, from 9 to 17 inches, is dense clay loam and is very dark grayish brown in the upper part and olive brown in the lower part. The underlying material, from 17 to 60

inches, is light olive brown clay loam in the upper part, olive brown and grayish brown clay loam in the middle part, and olive brown clay loam in the lower part. In places, the slopes are gentle. In other places, particularly the southwestern part of the county, the surface layer is silt loam or very fine sandy loam. In parts of this area the underlying material has a higher clay content.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the moderately well drained Emrick soil, the very poorly drained Parnell soil, and the poorly drained Tonka and Vallery soils. The Emrick soil is on rises, has a thicker subsoil and surface layer, and the subsoil is not dense. The Vallery soil has layers of lime accumulation within a depth of 16 inches and is around the margins of deep depressions. The Parnell and Tonka soils are in deep depressions.

Permeability in the Larson soil is slow, available water capacity is moderate, and runoff is slow. Permeability in the Cathay soil is slow, available water capacity is high, and runoff is slow. The surface is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing and to water erosion is low.

Most areas of these soils are used for cultivated crops, hay, and range. The potential is fair for range and for most engineering and recreational uses. The potential is poor for crops, windbreaks, and wetland wildlife habitat.

These soils are poorly suited to wheat, oats, barley, flax, and grass-legume hay. When these soils are tilled, the main management concern is improving soil tilth. Use of crop residue, green manure crops, and deep plowing to break up the dense subsoil can alleviate this limitation.

These soils are suited to pastureland or rangeland. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Larson soil is generally not suited to trees and shrubs in windbreaks and environmental plantings because of excess sodium and restricted root growth. The Cathay soil is suited to trees and shrubs in windbreaks and environmental plantings. Many climatically adapted species have the potential to grow well on the Cathay soils. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in the map unit are suited to sanitary facilities and buildings. The slow permeability is a limitation for septic tanks on the Cathay soil and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings that can be minimized by foundation drainage. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and

basement walls. Alternate sites are needed for septic tanks on the Larson soil. Onsite investigations are needed in areas proposed for irrigation to locate more clayey underlying material. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IVs.

74B—Cavour-Miranda complex, 1 to 6 percent slopes. This map unit consists of deep, nearly level and gently sloping soils on glacial till plains. The moderately well drained Cavour soil is in swales and on slopes and is 35 to 55 percent of the map unit. The moderately well drained and somewhat poorly drained Miranda soil is in micro depressions within swales and slopes and is 25 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 150 acres.

Typically, the Cavour soil has a surface layer of black silt loam, loam, or clay loam about 7 inches thick. The subsurface layer, from 7 to 10 inches, is very dark gray silt loam. The subsoil, from 10 to 23 inches, is dense black clay. The underlying material, from 23 to 60 inches, is dark grayish brown clay loam in the upper part, olive brown clay loam in the middle part, and light olive brown clay loam in the lower part. In places there is no subsurface layer, and the subsoil is less dense. In other places, particularly on valley foot slopes, the underlying material is shaly clay.

Typically, the Miranda soil has a surface layer of black loam about 3 inches thick. The subsurface layer is very dark gray loam about 2 inches thick. The subsoil, from 5 to 22 inches, is dense clay loam and is very dark gray in the upper part, black and very dark gray in the middle part, and very dark grayish brown in the lower part. The underlying material, from 22 to 60 inches, is dark grayish brown clay loam in the upper part and olive brown clay loam in the lower part.

Included with these soils in mapping, and making up 15 to 20 percent of the map unit, are small areas of the well drained Barnes and Buse soils, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Barnes and Buse soils are on the upper side slopes and crests of knolls. The Tonka and Parnell soils are in deep depressions.

Permeability in the Cavour soil is very slow, available water capacity is moderate, and runoff is medium. Permeability in the Miranda soil is slow, available water capacity is moderate or high, and runoff is medium. The surface is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing is low and to water erosion is moderate.

Most areas of these soils are used for range, pasture, and hayland. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. The potential is very poor for wetland wildlife habitat and fair

for range. It is generally not feasible to cultivate these soils because of excess sodium, salinity, and restricted root growth.

Using these soils for pastureland or hayland helps control erosion and protect the soil. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The soils in this map unit are poorly suited to sanitary facilities and buildings. The very slow permeability is a limitation for septic tanks that can be overcome by increasing the size of the absorption field. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. Better suited sites for septic tanks and buildings are generally nearby. These soils are not suited to wetland wildlife habitat.

This map unit is in capability subclass VIs.

75—Ryan silty clay. This deep, level, poorly drained soil is on stream bottom lands, low terraces, and glacial lake plains. Individual areas of this map unit are 5 to 350 acres.

Typically, the surface layer is black silty clay about 3 inches thick. The subsoil, from 3 to 16 inches, is dense black silty clay. The underlying material, from 16 to 60 inches, is black silty clay in the upper part, very dark gray silty clay in the middle part, and olive gray silty clay in the lower part.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the poorly drained Lamoure soil and the very poorly drained Rauville soil. They have a thicker surface layer, do not have excess sodium in the subsoil, and are in lower positions in the landscape.

This Ryan soil has very slow permeability. Available water capacity is moderate, and runoff is slow. In spring and after heavy rainy periods there is wetness and occasional surface ponding. The surface is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing is high.

Most areas of this soil are used for hay, pasture, and range. The potential is poor for crops, range, windbreaks, and for most engineering and recreational uses. The potential is fair for most wetland wildlife habitat. It is generally not feasible to cultivate this soil because of wetness, poor soil tilth, the dense subsoil, and the high hazard of soil blowing.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction, and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to sanitary facilities and buildings. Wetness is a severe limitation that can be over-

come in part by drainage; however, adequate outlets are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is suited to wetland wildlife habitat.

This map unit is in capability subclass VIs.

78—LaDelle-Aberdeen silt loams. This map unit consists of deep, level, moderately well drained soils on stream bottom lands. The LaDelle soil is on slightly higher convex side slopes and is 60 to 80 percent of the map unit. The Aberdeen soil is on slightly lower concave side slopes and is 20 to 40 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 75 acres.

Typically, the LaDelle soil has a surface layer of black silt loam about 17 inches thick. The subsoil, from 17 to 27 inches, is very dark gray silt loam. The underlying material, from 27 to 60 inches, is dark gray silt loam in the upper part and grayish brown clay loam in the lower part, with a buried surface layer of very dark clay loam from a depth of 42 to 46 inches. In places, the surface layer is silty clay loam.

Typically, the Aberdeen soil has a surface layer of black silt loam about 7 inches thick. The subsurface layer is very dark gray silt loam 7 to 9 inches thick. The subsoil, from 9 to 26 inches, is dense silty clay and is black in the upper and middle parts and very dark grayish brown in the lower part. The underlying material, from 26 to 60 inches, is silty clay loam and is grayish brown in the upper part, light brownish gray in the middle part, and olive in the lower part. In places the surface layer is silty clay loam.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the poorly drained Lamoure and Ryan soils in deeper swales.

Permeability in the LaDelle soil is moderate, available water capacity is high or very high, and runoff is slow. Permeability in the Aberdeen soil is slow, available water capacity is high, and runoff is slow. In some years, there is flooding early in spring and after unusually heavy rainy periods. In areas of the Aberdeen soil, the surface is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility of these soils to soil blowing is low.

Most areas of these soils are used for cultivated crops, hay, and pasture. The potential is good for crops, range, and windbreaks. The potential is fair for recreational uses and is poor for most engineering uses and wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. When these soils are tilled, the main management concern is maintaining good soil tilth. Use of crop residue helps control this limitation.

These soils are well suited to pastureland or rangeland. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The LaDelle soil is well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the LaDelle soils. The Aberdeen soil is suited to trees and shrubs in windbreaks and environmental plantings. Many climatically adapted species have the potential to grow well on the Aberdeen soils. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are poorly suited to sanitary facilities and buildings. Flooding is a severe limitation for buildings that can be partly overcome by constructing dikes and levees. Alternate sites are needed for buildings and related uses. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIIs.

82B—Darnen loam, 3 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on colluvial-alluvial material in stream valleys. Individual areas of this map unit are 5 to 125 acres.

Typically, the surface layer is black loam about 22 inches thick. The subsoil, from 22 to 34 inches, is very dark grayish brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 34 to 60 inches, is grayish brown loam in the upper part and dark grayish brown loam in the middle and lower parts. In places the slopes are moderate. In other places, the surface layer and subsoil are thinner, contain less clay, or are silt loam.

This soil has moderate permeability. Available water capacity is high, and runoff is medium. During periods of heavy runoff, small gullies are cut and fresh alluvium-colluvium is deposited. Susceptibility to soil blowing is slight and to water erosion is moderate.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is good for crops, range, windbreaks, and for recreational uses. The potential is fair for most engineering uses and poor for wetland wildlife habitat.

This soil is well suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are maintaining soil tilth and controlling water erosion. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture

rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is suited to sanitary facilities and buildings. The slow absorption of effluent is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. Sewage lagoons can be specially treated for seepage by sealing the bottom of the lagoon. This soil is poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

83—LaDelle silt loam. This deep, level, moderately well drained soil is on stream bottom lands. Individual areas of this map unit are 5 to 100 acres.

Typically, the surface layer is black silt loam about 17 inches thick. The subsoil, from 17 to 27 inches, is very dark gray silt loam. The underlying material, from 27 to 60 inches, is dark gray silt loam in the upper part and grayish brown clay loam in the lower part, with a buried surface layer of very dark gray clay loam from a depth of 42 to 46 inches. In places the surface layer is silty clay loam. In other places, the surface layer, subsoil, and underlying material are loam.

Included with this soil in mapping, and making up as much as 10 percent of the map unit, are small areas of the poorly drained Lamoure soil on lower positions in the landscape.

This LaDelle soil has moderate permeability. Available water capacity is high or very high, and runoff is slow. In some years there is flooding early in spring and after unusually heavy rainy periods. Susceptibility to soil blowing is low.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is good for crops, range, and windbreaks. The potential is fair for recreational uses and is poor for most engineering uses and wetland wildlife habitat.

This soil is well suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concern is maintaining good soil tilth. Use of crop residue helps control this limitation.

This soil is well suited to pastureland or rangeland. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and

weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is poorly suited to sanitary facilities and buildings. Flooding is a severe limitation that can be partly overcome for buildings by constructing dikes and levees. Alternate sites are needed for buildings and related uses. This soil is poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIc.

85—Lamoure silt loam. This deep, level, poorly drained soil is on stream bottom lands. Individual areas of this map unit range from 5 to 150 acres.

Typically, the surface layer is black silt loam in the upper part and black silty clay loam in the lower part, and is about 12 inches thick. The subsoil, from 12 to 26 inches, is very dark gray silty clay loam. The underlying material, from 26 to 60 inches, is silty clay loam and is dark grayish brown in the upper part and olive gray in the lower part. In places, the upper part of the surface layer is silty clay loam. In other places, the soil is slightly saline or moderately saline, and in places the soil is very poorly drained.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the moderately well drained LaDelle soil on swells.

This Lamoure soil has moderate permeability. Available water capacity is high, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding or flooding. Susceptibility to soil blowing is high.

Most areas of this soil are used for hay and range. The potential is poor for crops and for most engineering and recreational uses. The potential is good for range and windbreaks and is fair for wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are wetness, surface ponding or flooding, and control of soil blowing. Adequate outlets for drainage water are often difficult to locate. Maintaining surface drains and intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

Where drained, this soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings. Undrained areas are not suited to these uses.

This soil is poorly suited to sanitary facilities and buildings. Wetness and flooding are severe limitations that can be overcome in part by drainage; however, adequate outlets for drainage are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is suited to wetland wildlife habitat.

This map unit is in capability subclass IVw.

86—LaDelle silt loam, channeled. This deep, level, moderately well drained soil is on stream bottom lands. Individual areas of this map unit are 5 to 200 acres.

Typically, the surface layer is black silt loam about 17 inches thick. The subsoil, from 17 to 27 inches, is very dark gray silt loam. The underlying material, from 27 to 60 inches, is dark gray silt loam in the upper part and grayish brown clay loam in the lower part, with a buried surface layer of very dark gray clay loam from a depth of 42 to 46 inches. In some places, the surface layer is silty clay loam or loam.

Included with this soil in mapping, and making up 10 to 20 percent of the map unit, are small areas of the poorly drained Colvin, Lamoure, and Marysland soils and the very poorly drained Rauville soil. They are in channels and are more poorly drained.

This LaDelle soil has moderate permeability. Available water capacity is high or very high, and runoff is slow. There is often flooding early in spring and after unusually heavy rainy periods. The many channels restrict cultivation. Susceptibility to soil blowing is low.

Most areas of this soil are used for pasture and range. The potential is good for range and windbreaks and is fair for wetland wildlife habitat. The potential is poor for crops and for most engineering and recreational uses. It is generally not feasible to cultivate this soil because of frequent flooding and the many channels.

This soil is well suited to pastureland or rangeland. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing will help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is poorly suited to sanitary facilities and buildings. Flooding is a severe limitation that can be partly overcome for buildings by constructing dikes and levees. Alternate sites are needed for buildings and related uses. This soil is suited to wetland wildlife habitat.

This map unit is in capability subclass VIe.

89—Grano silty clay. This deep, level, poorly drained and very poorly drained soil is on glacial lake and till

plains. Individual areas of this map unit are 5 to 250 acres.

Typically, the surface layer is black silty clay about 10 inches thick. The underlying material, from 10 to 60 inches, is very dark gray and dark gray clay in the upper part, dark gray clay in the middle part, and olive gray clay in the lower part. In places, the surface layer is silty clay loam or clay, and in other places it is moderately saline.

Included with this soil in mapping, and making up 10 to 20 percent of the map unit, are small areas of the very poorly drained Parnell soil and the poorly drained Tonka and Vallery soils. The Parnell and Tonka soils have a subsoil and are in the same landscape position as the Grano soil. The Vallery soil has layers of lime accumulation within a depth of 16 inches of the surface and is on the margins of depressions.

This soil has slow permeability. Available water capacity is high, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. Susceptibility to soil blowing is high.

Most areas of this soil are used for hay, pasture, and range. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. The potential is fair for range and good for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of wetness, surface ponding, and the absence of suitable outlets.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to sanitary facilities and buildings. Wetness is a severe limitation that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass Vw.

90—Parnell and Lallie soils, ponded. This map unit consists of deep, level, very poorly drained soils on glacial till and lake plains. Any one area can consist entirely of all Lallie soil or all Parnell soil or any combination of each. Typically, the Lallie soil is on lake plains and the Parnell soil is on glacial till. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the Parnell soil has a surface layer of black silty clay loam about 14 inches thick. The subsoil, from 14 to 36 inches, is black silty clay. The underlying material, from 36 to 60 inches, is silty clay loam and is dark gray in the upper part and olive gray in the lower part.

Typically, the Lallie soil has a surface layer of black loam, silt loam, sandy loam, or silty clay loam about 2 inches thick. The underlying material, from 2 to 60

inches, is silty clay in the upper part, multicolored silty clay in the middle part, and olive and light olive brown silty clay in the lower two parts.

These soils have slow permeability. Available water capacity is high, and runoff is ponded. These soils are often ponded throughout the year. Susceptibility to soil blowing is low.

Most areas of these soils are used for wetland wildlife habitat (fig. 9). The potential is poor for crops, range, windbreaks, and for most engineering and recreational uses. The potential is good for wetland wildlife habitat. It is generally not feasible to cultivate these soils for cropland, rangeland, or windbreaks because of surface ponding and the absence of suitable outlets.

The soils in this map unit are not suited to sanitary facilities and buildings. Surface ponding is a severe limitation. Outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. These soils are well suited to wetland wildlife habitat.

This map unit is in capability subclass VIIIw.

91C—Sioux gravelly loam, 1 to 9 percent slopes.

This deep, nearly level to moderately sloping, excessively drained soil is on glacial outwash plains and stream terraces. The soil is very shallow over sand and gravel. Individual areas of this map unit are 5 to 200 acres.

Typically, the surface layer is black gravelly loam about 5 inches thick. The next layer, from 5 to 9 inches, is very dark grayish brown gravelly loam. The underlying material, from 9 to 60 inches, is dark brown, brown, and dark yellowish brown very gravelly sand. In places the surface layer is loam, coarse sandy loam, or sandy loam; and in places the subsoil is sandy loam or loam. In some of these areas, the soil is somewhat excessively drained, the surface layer is more than 5 inches thick, and the depth to sand and gravel is 9 to 20 inches.

This soil has rapid permeability. Available water capacity is very low, and runoff is slow. Susceptibility to soil blowing is low and to water erosion is low or moderate.

Most areas of this soil are used for hay and pasture. The potential is good for most engineering and recreational uses. The potential is poor for crops and windbreaks, fair for range, and very poor for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of very low available water capacity and low natural fertility.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Alternate sites are needed for sewage



Figure 9.—Typical vegetation and surface ponding of Parnell and Lallie soils used for wetland wildlife habitat.

lagoons. This soil is not suited to wetland wildlife habitat. This map unit is in capability subclass VIs.

91E—Sioux gravelly loam, 9 to 25 percent slopes. This deep, strongly sloping and moderately steep, excessively drained soil is on glacial moraines, glacial outwash plains, and stream terraces. The soil is shallow over sand and gravel. Individual areas of this map unit are 5 to 250 acres.

Typically, the surface layer is black gravelly loam about 5 inches thick. The next layer, from 5 to 9 inches, is very dark grayish brown gravelly loam. The underlying material, from 9 to 60 inches, is dark brown, brown, and dark yellowish brown very gravelly sand. In places the surface layer is loam, coarse sandy loam, or sandy loam, and in places the subsoil is sandy loam or loam. In some of these areas the soil is somewhat excessively drained, the surface layer is more than 5 inches thick, and the depth to sand and gravel is 9 to 20 inches.

This soil has rapid permeability. Available water capacity is very low, and runoff is rapid. Susceptibility to soil blowing is low and to water erosion is high or very high.

Most areas of this soil are used for range. The potential is fair for range and for most engineering and recreational uses. The potential is poor for crops and windbreaks and is very poor for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of very low available water capacity, low natural fertility, and the high hazard of water erosion.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Slope is a limitation for buildings that can be overcome by cut and fill operations in areas that have 9 to 15 percent slopes. Alternate sites are needed for sewage lagoons, buildings, and septic tanks where areas have 15 to 25 percent slopes. This soil is not suited to wetland wildlife habitat.

This map unit is in capability subclass VIIIs.

98C—Coe shaly loam, 1 to 9 percent slopes. This deep, nearly level to moderately sloping, excessively drained soil is on glacial outwash plains and stream terraces. The soil is very shallow over sand and gravel that is mainly shale in origin. Individual areas of this map unit are 5 to 150 acres.

Typically, the surface layer is black shaly loam about 7 inches thick. The underlying material, from 7 to 60 inches, is dark gray and dark grayish brown and is shaly coarse sand in the upper part and shaly coarse sand and gravel in the lower part. In places, the surface layer is loam or coarse sandy loam. It is thicker on some lower side slopes and thinner and eroded on the tops of some knolls and ridges. In other places, there is no shale in the underlying material.

Included with this soil in mapping, and making up 15 to 20 percent of the map unit, are small areas of the well drained Brantford and Vang soils. They are deeper to shaly sand and gravel and are on the lower side slopes and in swales.

This Coe soil has moderate or moderately rapid permeability in the upper part and very rapid permeability in the underlying material. Available water capacity is very low, and runoff is slow. Susceptibility to soil blowing is moderate and to water erosion is low or moderate.

Most areas of this soil are used for tame and native hay. The potential is poor for crops and windbreaks and is fair for range and most recreational uses. The potential is good for most engineering uses and is very poor for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of very low available water capacity and low natural fertility.

Using this soil for pastureland or rangeland helps control erosion and protect the soil. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Alternate sites are needed for sewage lagoons. This soil is not suited to wetland wildlife habitat.

This map unit is in capability subclass VIs.

98E—Coe shaly loam, 9 to 25 percent slopes. This deep, strongly sloping and moderately steep, excessively drained soil is on glacial moraines, glacial outwash plains, and stream terraces. The soil is very shallow over sand and gravel that is mainly shale in origin. Individual areas of this map unit are 5 to 350 acres.

Typically, the surface layer is black shaly loam about 7 inches thick. The underlying material, from 7 to 60 inches, is dark gray and dark grayish brown and is shaly coarse sand in the upper part and shaly coarse sand and gravel in the lower part. In places, the surface layer is loam or coarse sandy loam. It is thicker on some

lower side slopes and thinner and eroded on some hill-tops and ridges. In other places, shale is not in the underlying material.

Included with this soil in mapping, and making up 15 to 20 percent of the map unit, are small areas of the well drained Brantford and Vang soils. The included soils are deeper to shaly sand and gravel and are on the lower side slopes and in swales.

This soil has moderate or moderately rapid permeability in the upper part and very rapid permeability in the underlying material. Available water capacity is very low, and runoff is rapid. Susceptibility to soil blowing is moderate and to water erosion is high or very high.

Most areas of this soil are used for range. The potential is fair for range and for most engineering and recreational uses. The potential is poor for crops and windbreaks and very poor for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of very low available water capacity, low natural fertility, and the high hazard of water erosion.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Slope is a limitation for buildings that can be overcome by cut and fill operations in areas that have 9 to 15 percent slopes. Alternate sites are needed for sewage lagoons, buildings, and septic tanks where areas have 15 to 25 percent slopes. This soil is not suited to wetland wildlife habitat.

This map unit is in capability subclass VIIIs.

99C—Claire loamy coarse sand, loamy substratum, 1 to 9 percent slopes. This deep, nearly level to moderately sloping, excessively drained soil is in dry lake basins. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the surface layer is very dark grayish brown loamy coarse sand about 5 inches thick. The next layer, from 5 to 42 inches, is dark grayish brown and grayish brown coarse sand. A buried surface layer of very dark grayish brown and black loamy coarse sand is common throughout this layer. The underlying material, from 42 to 60 inches, is black and very dark grayish brown sandy clay loam. In places, the surface layer through the underlying material is coarse sand and fine gravel. In other places the surface is stony.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the somewhat poorly drained Aquents soil and the poorly drained Minnewaukan and Lallie soils. The Aquents, Minnewaukan, and Lallie soils are in lower positions adjacent to beaches and sandbars.

This Claire soil has very rapid permeability in the upper part and moderately slow permeability in the lower part. Available water capacity is very low, and runoff is slow. Susceptibility to soil blowing is very high and to water erosion is low.

Most areas of this soil are used for range. The potential is poor for crops and windbreaks and fair for range and recreational uses. The potential is good for most engineering uses and is very poor for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of very low available water capacity, low natural fertility, and the high hazard of soil blowing.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass VIIc.

101—Lallie loam. This deep, level, poorly drained soil is in dry lake basins. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the surface layer is black loam about 2 inches thick. The underlying material, from 2 to 60 inches, is silty clay and is gray in the upper part, multicolored in the middle part, and olive and light olive brown in the lower two parts. In places, the soil is slightly saline or moderately saline. In other places, the surface layer is silt loam, sandy loam, or silty clay loam.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the poorly drained Minnewaukan soil, the somewhat poorly drained Aquents soil, and the excessively drained Claire soil. The Minnewaukan soil has a loamy fine sand surface layer and fine sand underlying material, is adjacent to beaches, and is on sandbars. The Aquents soil is on slightly higher positions adjacent to beaches. The Claire soil has coarse sand and gravel throughout and is on beaches.

This Lallie soil has slow permeability. Available water capacity is high, and runoff is slow. Early in spring and after heavy rainy periods this soil is ponded. The water table is within a depth of 5 feet throughout most of the year. Susceptibility to soil blowing is high.

Most areas of this soil are used for hay and range. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. The potential is fair for range and is good for wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are wetness, surface ponding of

water (fig. 10), controlling soil blowing, and low natural fertility. Adequate outlets for drainage water are often difficult to locate. Maintaining surface drains helps reduce wetness and surface ponding. Intensive use of annual buffer strips and stubble mulching help alleviate soil blowing. Making recommended fertilizer applications and planting soil-building crops such as legumes help improve the natural fertility of the soil.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet



Figure 10.—Surface condition of the Lallie soils following removal of surface water.

reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to sanitary facilities and buildings. Wetness and flooding are severe limitations. Wetness can be overcome by adding fill, and flooding can be overcome in part by constructing dikes and levees. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass IVw.

104—Lallie loam, saline. This deep, level, poorly drained, moderately saline soil is in dry lake basins. Individual areas of this map unit are 5 to 200 acres.

Typically, the surface layer is black loam about 2 inches thick. The underlying material, from 2 to 60 inches, is silty clay and is gray in the upper part, multicolored in the middle part, and olive and light olive brown in the lower two parts. In places, the soil is slightly saline or strongly saline. In other places, the surface layer is silt loam, sandy loam, or silty clay loam.

Included with this soil in mapping, and making up as much as 5 percent of the map unit, are some gently sloping to steep soils on short slopes.

This Lallie soil has slow permeability. Available water capacity is moderate, and runoff is slow. Early in spring and after heavy rainy periods this soil is ponded. The water table is within a depth of 5 feet throughout most of the year. The high salt content restricts plant growth. Susceptibility to soil blowing is high.

Most areas of this soil are used for hay and range. The potential is poor for crops, range, windbreaks, and for most engineering and recreational uses. The potential is good for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of wetness, surface ponding of water, and salinity.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to sanitary facilities and buildings because of wetness and flooding. Wetness can be overcome by adding fill, and flooding can be overcome in part by constructing dikes and levees. The salinity hinders landscaping. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass VI.

106—Lallie loam, wet. This deep, level, very poor drained soil is in lake basins. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the surface layer is black loam about 2 inches thick. The underlying material, from 2 to 60

inches, is silty clay and is gray in the upper part, multicolored in the middle part, and olive and light olive brown in the lower two parts. In places the soil is slightly saline or moderately saline. In other places, the surface layer is silt loam, sandy loam, or silty clay loam.

This soil has slow permeability. Available water capacity is high, and runoff is slow. Early in spring and after heavy rainy periods this soil is ponded. The water table is near the surface throughout most of the year. Susceptibility to soil blowing is high.

Most areas of this soil are used for range and wetland wildlife habitat. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. The potential is fair for range and is good for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of wetness, surface ponding of water, and the absence of suitable outlets.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to sanitary facilities and buildings because of wetness and flooding. These limitations can be partly overcome by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass Vw.

107—Minnewaukan loamy fine sand, 1 to 3 percent slopes. This deep, nearly level, poorly drained soil is in dry lake basins. Individual areas of this map unit are 5 to 100 acres.

Typically, the surface layer is very dark gray loamy fine sand about 2 inches thick. The next layer is very dark grayish brown loamy fine sand 2 to 5 inches. The underlying material, from 5 to 60 inches, is olive gray, grayish brown, and dark grayish brown fine sand in the two upper parts and olive gray fine sand in the two lower parts. In places the surface layer is fine sandy loam or loamy sand. In other places the slope is gentle, and in places the soil is slightly saline or moderately saline.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the poorly drained Lallie soil which has silty clay underlying material and is adjacent to beaches and sandbars on the lake plain.

This Minnewaukan soil has rapid permeability. Available water capacity is low, and runoff is slow. Early in spring and after heavy rainy periods there is wetness and some surface ponding. The water table is within a depth of 5 feet throughout most of the year. Susceptibility to soil blowing is very high.

Most areas of this soil are used for range. The potential is poor for crops, for most engineering and recre-

ational uses, and for wetland wildlife habitat. The potential is fair for range and is good for windbreaks.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are wetness and control of soil blowing. Adequate outlets for drainage water are often difficult to locate. Maintaining surface drains and intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

If drained, this soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings. Undrained areas are not suited to these uses.

This soil is poorly suited to sanitary facilities and buildings. Wetness and flooding are severe limitations that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IVs.

109—Aqueuts. These deep, level to moderately sloping, somewhat poorly drained soils are on glacial till. Individual areas of this map unit are 5 to 500 acres.

Typically, the surface layer is black silty clay loam about 1 inch thick. The underlying material, from 1 inch to 60 inches, is multicolored silty clay. In places the surface is stony, and in other places the soil is slightly saline or moderately saline. In other places the subsoil is clay loam or loam.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the poorly drained Lallie and Minnewaukan soils and the excessively drained Claire soil. The Lallie soil is on lake plains. The Minnewaukan and Claire soils are sandy through the underlying material and are on beaches. In addition, the Minnewaukan soil is on sandbars in lake basins.

The soils in this map unit have slow permeability. Available water capacity is high, and runoff is slow to rapid. Susceptibility to soil blowing is high and to water erosion is low to high.

Most areas of these soils are used for range. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. The potential is fair for range and wetland wildlife habitat.

These soils are poorly suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are low natural fertility and

control of soil blowing and water erosion. Applying recommended fertilizer and planting soil-building crops such as legumes can improve natural fertility. Intensive use of annual buffer strips and stubble mulching can alleviate soil blowing. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are poorly suited to sanitary facilities and buildings. The slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings that can be minimized by foundation drainage.

These soils are suited to wetland wildlife habitat.

This map unit is in capability subclass IVw.

110B—Aastad-Bottineau loams, 3 to 6 percent slopes. This map unit consists of deep, gently sloping soils on glacial till plains and moraines. The moderately well drained Aastad soil is in swales and is 40 to 60 percent of the map unit. The well drained Bottineau soil is on knolls and higher positions and is 35 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 250 acres.

Typically, the Aastad soil has a surface layer of black loam about 18 inches thick. The subsoil, from 18 to 38 inches, is very dark grayish brown clay loam in the upper part and dark grayish brown clay loam in the lower part. The underlying material, from 38 to 60 inches, is grayish brown loam in the upper part and light olive gray loam in the lower part.

Typically, the Bottineau soil has a black surface layer about 9 inches thick. It is loam in the upper part and clay loam in the lower part. The subsoil, from 9 to 19 inches, is clay loam. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The underlying material, from 19 to 60 inches, is loam. It is light olive brown in the upper and middle parts and olive brown in the lower part.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the very poorly drained Parnell soil and the poorly drained Tonka soil. Both of these soils are in deep depressions.

The soils in this map unit have moderately slow permeability. Available water capacity is high, and runoff is medium. Susceptibility to soil blowing is low and to water erosion is moderate.

Most areas of these soils are used for woodland pasture, but some areas cleared of trees are used for crops. The potential is good for crops, range, windbreaks, and

recreational uses. The potential is fair for most engineering uses and is very poor for wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. Controlling water erosion and maintaining good soil tilth are the main management concerns. Use of crop residue and planting of grassed waterways where necessary help control erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the Aastad soil. Nearly all climatically adapted species have the potential to grow well on the Bottineau soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings. When these soils are cleared for cultivation, remaining belts of native trees serve as natural windbreaks.

The soils in this map unit are suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings on the Aastad soil and can be minimized by foundation drainage or by locating structures on the higher lying Bottineau soil. Shrink-swell is a limitation for buildings that can be overcome by reinforcing basement walls and foundations. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

112F—Edgeley Variant loam, 15 to 60 percent slopes. This deep, moderately steep to very steep, well drained soil is on glacial till plains, glacial moraines, and stream breaks. The glacial till is underlain by shale. Individual areas of this map unit are 5 to 300 acres.

Typically, the surface layer is black loam about 11 inches thick. The underlying material, from 11 to 60 inches, is dark grayish brown clay loam in the upper part and dark olive gray very shaly loam in the lower part. In places, the underlying material below a depth of 40 inches is consolidated shale. In other places this soil has a subsoil.

Included with this soil in mapping, and making up 10 to 20 percent of the map unit, are small areas of the moderately well drained Aastad soil and the well drained Bottineau and Buse soils. These soils do not have large quantities of shale in the underlying material. The Aastad soil is in swales and on the concave lower side slopes, the Bottineau soil is on side slopes, and the Buse soil is on ridges and hilltops.

This Edgeley soil has moderate permeability. Available water capacity is moderate, and runoff is very rapid.

Susceptibility to soil blowing is slight and to water erosion is very high.

Most areas of this soil are used for woodland pasture. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. The potential is fair for range and is very poor for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of slope and the high hazard of water erosion.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to trees and shrubs in windbreaks and environmental plantings. It is suited to plantings for wildlife habitat, recreation, and beautification where survival, growth, and vigor are not required or expected to be optimum.

This soil is poorly suited to sanitary facilities and buildings because of the severe limitation of slope. Alternate sites are needed for buildings and related uses. This soil is not suited to wetland wildlife habitat.

This map unit is in capability subclass VIIe.

113C—Bottineau loam, 6 to 9 percent slopes. This deep, gently rolling, well drained soil is on glacial till plains and moraines. Individual areas of this map unit are 5 to 200 acres.

Typically, the surface layer is black loam in the upper part, clay loam in the lower part, and about 9 inches thick. The subsoil, from 9 to 19 inches, is very dark grayish brown clay loam in the upper part and dark grayish brown clay loam in the lower part. The underlying material, from 19 to 60 inches, is light olive brown loam in the upper part and olive brown loam in the lower part. In places, generally on tops of knolls and ridges, the surface layer is thinner, and there is no subsoil.

Included with this soil in mapping, and making up 15 to 20 percent of the map unit, are small areas of the moderately well drained Aastad soil, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Aastad soil has a thicker subsoil and surface layer and is in swales and on lower slopes. The Tonka and Parnell soils are in deep depressions.

This Bottineau soil has moderately slow permeability. Available water capacity is high, and runoff is rapid. Susceptibility to soil blowing is low and to water erosion is high.

Most areas of this soil are used for woodland pasture, but some areas are cleared of trees and used for crops. The potential is good for range, windbreaks, and recreational uses. The potential is very poor for wetland wildlife habitat and is fair for crops and most engineering uses.

This soil is suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concern is control of water erosion. Proper

placement of grassed waterways and use of crops residue help reduce this limitation.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growth of nearly all climatically adapted species. Grass and weeds are eliminated before the trees are planted, and ground cover regrowth is controlled for the entire life of the plantings.

This soil is suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

113D—Bottineau loam, 9 to 15 percent slopes. This deep, rolling, well drained soil is on glacial till plains and moraines. Individual areas of this map unit are 5 to 500 acres.

Typically, the surface layer is black loam in the upper part, black clay loam in the lower part, and about 9 inches thick. The subsoil, from 9 to 19 inches, is very dark grayish brown clay loam in the upper part and dark grayish brown clay loam in the lower part. The underlying material, from 19 to 60 inches, is light olive brown loam in the upper and middle parts and olive brown loam in the lower part. In places, generally on hilltops and ridges, the surface layer is thinner, and there is no subsoil.

Included with this soil in mapping, and making up 15 to 20 percent of the map unit, are small areas of the moderately well drained Aastad soil, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Aastad soil has a thicker subsoil and surface layer and is in swales and on lower slopes. The Tonka and Parnell soils are in deep depressions.

This Bottineau soil has moderately slow permeability. Available water capacity is high, and runoff is very rapid. Susceptibility to soil blowing is low and to water erosion is very high.

Most areas of this soil are used for woodland pasture. The potential is fair for crops and for most engineering and recreational uses. The potential is good for range and windbreaks and is very poor for wetland wildlife habitat.

This soil is suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concern is control of water erosion. Proper placement of grassed waterways and use of crop residue can reduce this limitation.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing nearly all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Slope is a limitation for buildings that can be overcome by cut and fill operations, and shrink-swell is a limitation that can be overcome by reinforcing foundations and basement walls. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IVe.

119—Aberdeen silty clay loam. This deep, level, moderately well drained soil is on glacial lake plains. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is very dark gray silt loam 2 inches thick. The subsoil, from 9 to 26 inches, is dense silty clay and is black in the upper part and very dark grayish brown in the lower part. The underlying material, from 26 to 60 inches, is silty clay loam and is grayish brown in the upper part, light brownish gray in the middle part, and olive in the lower part. In places, the surface layer is silt loam. In other places, the surface layer is loam or clay loam, and the underlying material is clay loam.

Included with this soil in mapping, and making up as much as 20 percent of the map unit, are small areas of the poorly drained Colvin and Hegne soils and the moderately well drained Gardena and Overly soils. The Colvin and Hegne soils have layers of lime accumulation within a depth of 16 inches of the surface and are in some of the deeper swales. The soils in this map unit are moderately saline. The Gardena and Overly soils do not have a dense subsoil and are on some of the higher swells.

This Aberdeen soil has slow permeability. Available water capacity is high, and runoff is slow. The surface is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing is low.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is fair for crops, windbreaks, and recreational uses. The potential is good for range, poor for most engineering uses, and very poor for wetland wildlife habitat.

This soil is suited to wheat, oats, barley, flax, and grass-legume hay. If the soil is tilled, the main management concern is maintaining good soil tilth. Use of crop residue helps control this limitation.

This soil is well suited to pastureland or rangeland. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for grazing many climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is poorly suited to sanitary facilities and buildings. The slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIs.

122—Fram-Cathay loams, 1 to 3 percent slopes.

This map unit consists of deep, nearly level soils on glacial till plains. The somewhat poorly drained Fram soil is in swales and on concave side slopes of rises and is 50 to 60 percent of the map unit. The moderately well drained Cathay soil is on rises slightly above the Fram soil and is 30 to 40 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 600 acres.

Typically, the surface layer of the Fram soil is black loam in the upper part, very dark gray loam in the lower part, and 13 inches thick. The underlying material, from 13 to 27 inches, is grayish brown loam. The underlying material, from 27 to 60 inches, is light olive brown and olive brown loam. In places, particularly the southwestern part of the county, the surface layer to the underlying material is silt loam or very fine sandy loam. In parts of this area there is a higher clay content in the underlying material. In other places, the surface layer through the underlying material has higher clay content. In parts of this area the soil is moderately saline.

Typically, the Cathay soil has a surface layer of black loam about 8 inches thick. The subsurface layer, from 8 to 9 inches, is dark grayish brown loam. The subsoil, from 9 to 17 inches, is dense clay loam and is very dark grayish brown in the upper part and olive brown in the lower part. The underlying material, from 17 to 60 inches, is clay and is light olive brown in the upper part, olive brown and grayish brown in the middle part, and olive brown in the lower part. In places the subsoil is denser, and in some of these areas the soil is somewhat

poorly drained. In other places, particularly the southwestern part of the county, the surface layer is silt loam or very fine sandy loam. In parts of this area the underlying material has a higher clay content.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the moderately well drained Emrick soil, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Emrick soil has a thicker subsoil and surface layer, a less dense subsoil, and is on the rises. The Tonka and Parnell soils are in deep depressions.

Permeability in the Fram soil is moderate, available water capacity is high, and runoff is slow. Permeability in the Cathay soil is slow, available water capacity is high, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness. The surface in areas of the Cathay soil is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, and windbreaks. The potential is fair for recreational uses and is poor for most engineering uses and wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. Maintaining good soil tilth and controlling soil blowing are the main management concerns. Use of crop residue and intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing, help keep the pasture and soil in good condition.

The Fram soil is well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the Fram soil. The Cathay soil is suited to trees and shrubs in windbreaks and environmental plantings. Many climatically adapted species have the potential to grow well on the Cathay soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are poorly suited to sanitary facilities and buildings. The slow permeability is a limitation for septic tanks on the Cathay soil and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings that can be minimized by foundation drainage. Shrink-swell is a limitation for buildings on the Cathay soil and can be overcome by reinforcing foundations and basement walls. In areas proposed for irrigation, onsite investigations are needed to locate more clayey underlying material. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIIs.

123—Emrick-Cathay loam, 1 to 3 percent slopes.

This map unit consists of deep, nearly level, moderately drained soils on glacial till plains. The Emrick soil is on gentle rises and in some swales and is 50 to 75 percent of the map unit. The Cathay soil is in swales and on some rises and is 25 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 500 acres.

Typically, the Emrick soil has a surface layer of black loam about 16 inches thick. The subsoil, from 16 to 34 inches, is very dark grayish brown loam. The underlying material, from 34 to 60 inches, is light olive brown loam in the upper and middle parts and olive brown loam in the lower part. In places, particularly the southwestern part of the county, the surface layer to the underlying material is silt loam or very fine sandy loam. In addition, in parts of this area the underlying material has higher clay content. In other places the soil is well drained, and the black surface layer is 8 to 16 inches thick.

Typically, the Cathay soil has a surface layer of black loam about 8 inches thick. The subsurface layer, from 8 to 19 inches, is dark grayish brown loam. The subsoil, from 9 to 17 inches, is dense clay loam and is very dark grayish brown in the upper part and olive brown in the lower part. The underlying material, from 17 to 60 inches, is clay loam and is light olive brown in the upper part, olive brown and grayish brown in the middle part, and olive brown in the lower part. In places the subsoil is denser, the surface layer is thinner, and the soil is somewhat poorly drained. In other places, particularly the southwestern part of the county, the surface layer is silt loam or very fine sandy loam. In addition, in parts of this area the underlying material has higher clay content.

Included with these soils in mapping, and making up as much as 20 percent of the map unit, are small areas of the somewhat poorly drained Fram soil, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Fram soil has layers of lime accumulation within a depth of 16 inches and is around the margins of deep depressions. The Tonka and Parnell soils are in deep depressions.

Permeability in the Emrick soil is moderate, available water capacity is high, and runoff is slow. Permeability in the Cathay soil is slow, available water capacity is high, and runoff is slow. The surface layer in areas of Cathay soil is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing is moderate and to water erosion is low.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, windbreaks, and recreational uses. The potential is fair for

most engineering uses and is poor for wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. Maintaining good soil tilth and controlling soil blowing are the main management concerns. Use of crop residue, field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Emrick soil is well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the Emrick soil. The Cathay soil is suited to trees and shrubs in windbreaks and environmental plantings. Many climatically adapted species have the potential to grow well on the Cathay soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The slow permeability is a limitation for septic tanks on the Cathay soil and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings on the Cathay soil that can be minimized by foundation drainage or by locating structures on the higher lying Emrick soil. Shrink-swell is a limitation for buildings on the Cathay soil that can be overcome by reinforcing foundations and basement walls. Sewage lagoons on the Emrick soil can be treated for seepage by sealing the bottom of the lagoon. In areas proposed for irrigation, onsite investigations are needed to locate more clayey underlying material. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIIs.

123B—Emrick-Cathay loams, 3 to 6 percent slopes.

This map unit consists of deep, gently sloping, moderately well drained soils on glacial till plains. The Emrick soil is on side slopes and in some swales and is 50 to 75 percent of the map unit. The Cathay soil is in swales and on some side slopes and is 25 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 150 acres.

Typically, the Emrick soil has a surface layer of black loam about 16 inches thick. The subsoil, from 16 to 34 inches, is very dark grayish brown loam. The underlying material, from 34 to 60 inches, is light olive brown loam in the upper and middle parts and olive brown loam in the lower part. In places, particularly the southwestern part of the county, the surface layer and subsoil are silt loam or very fine sandy loam. In addition, in parts of this area the underlying material has higher clay content. In

other places, usually on the tops of knolls, the soil is well drained, and the black surface layer is 8 to 16 inches thick.

Typically, the Cathay soil has a surface layer of black loam about 8 inches thick. The subsurface layer, from 8 to 9 inches, is dark grayish brown loam. The subsoil, from 9 to 17 inches, is dense clay loam and is very dark grayish brown in the upper part and olive brown in the lower part. The underlying material, from 17 to 60 inches, is clay loam and is light olive brown in the upper part, olive brown and grayish brown in the middle part, and olive brown in the lower part. In places, the subsoil is denser, and in some of these areas the surface layer is thinner, and the soil is somewhat poorly drained. In other places, particularly the southwestern part of the county, the surface layer is silt loam or very fine sandy loam. In addition, in parts of this area the underlying material has higher clay content.

Included with these soils in mapping, and making up as much as 20 percent of the map unit, are small areas of the somewhat poorly drained Fram soil, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Fram soil has layers of lime accumulation within a depth of 16 inches and is around the margins of deep depressions. The Tonka and Parnell soils are in deep depressions.

Permeability in the Emrick soil is moderate, available water capacity is high, and runoff is medium. Permeability in the Cathay soil is slow, available water capacity is high, and runoff is medium. The surface in areas of the Cathay soil is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing and water erosion is moderate.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, windbreaks, and recreational uses. The potential is fair for most engineering uses and is very poor for wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are maintaining good soil tilth and controlling soil blowing and water erosion. Use of crop residue helps maintain good soil tilth. Use of field windbreaks, annual buffer strips, and stubble mulching can alleviate soil blowing. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Emrick soil is well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well on the Emrick soil. The Cathay soil is suited to trees and shrubs in windbreaks and environmental plantings. Many climati-

cally adapted species have the potential to grow well on the Cathay soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The slow permeability is a limitation for septic tanks on the Cathay soil and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings on the Cathay soil and can be minimized by foundation drainage or by locating structures on the higher lying Emrick soil. Shrink-swell is a limitation for buildings on the Cathay soil and can be overcome by reinforcing foundations and basement walls. Sewage lagoons on the Emrick soil can be treated for seepage by sealing the bottom of the lagoon. In areas proposed for irrigation, onsite investigations are needed to locate more clayey underlying material. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

124C—Heimdal-Sioux loams, 3 to 9 percent slopes.

This map unit consists of deep, gently sloping and moderately sloping soils on glacial till plains and eskers. The well drained Heimdal soil is on side slopes and is 35 to 50 percent of the map unit. The excessively drained Sioux soil is very shallow over sand and gravel, is on knolls and ridges, and is 30 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 225 acres.

Typically, the Heimdal soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 19 inches, is very dark grayish brown loam in the upper part and dark brown or brown loam in the lower part. The underlying material, from 19 to 60 inches, is grayish brown loam in the upper part, yellowish brown loam in the middle part, and yellowish brown sandy loam in the lower part. In places there are more coarse fragments than normal. In other places the surface layer is thinner and moderately eroded, and there is no subsoil.

Typically, the Sioux soil has a surface layer of black loam about 5 inches thick. The next layer, from 5 to 9 inches, is very dark grayish brown gravelly loam. The underlying material, from 9 to 60 inches, is dark brown, brown, and dark yellowish brown very gravelly sand. In places there is more coarse sand and less gravel than normal, and the surface layer in some places is moderately eroded. In other places the soil is somewhat excessively drained, the surface layer is more than 5 inches thick, and the depth to sand and gravel is 9 to 20 inches.

Included with these soils in mapping, and making up 10 to 20 percent of the map unit, are small areas of the moderately well drained Emrick soil. This soil has a thicker subsoil and surface layer and is in swales and on lower slopes.

Permeability in the Heimdal soil is moderate, available water capacity is high, and runoff is medium and rapid. Permeability in the Sioux soil is very rapid, available water capacity is very low, and runoff is slow. Susceptibility to soil blowing is moderate and to water erosion is low to high.

Most areas of these soils are used for cultivated crops, hay, and pasture. The potential is good for range and for most engineering and recreational uses. The potential is fair for crops and windbreaks and is very poor for wetland wildlife habitat.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. When the soils are tilled, the main management concerns are the very low available water capacity in areas of the Sioux soil and control of soil blowing and water erosion. High stubble, use of field windbreaks, annual buffer strips, and stubble mulching help alleviate the very low available water capacity and soil blowing. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management problems. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Heimdal soil is well suited to trees and shrubs in windbreaks and environmental plantings. The Sioux soil is not suited because of very low available water capacity. Nearly all climatically adapted species have the potential to grow well on the Heimdal soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates on the Sioux soil. Sewage lagoons on the Heimdal soil can be treated for seepage by sealing the bottom of the lagoon. Alternate sites are needed for sewage lagoons on the Sioux soil. These soils are not suited to wetland wildlife habitat.

This map unit is in capability subclass IVe.

125C—Heimdal-Emrick very stony loams, 1 to 9 percent slopes. This map unit consists of deep, nearly level to moderately sloping, very stony soils on glacial till plains and moraines. Stones, mainly on knolls and ridges, cover 3 to 15 percent of the surface. The well drained Heimdal soil is on knolls, ridges, and upper slopes and is 50 to 70 percent of the map unit. The moderately well drained Emrick soil is in swales and on lower slopes and is 30 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 175 acres.

Typically, the Heimdal soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 19 inches, is very dark grayish brown loam in the upper part and dark brown or brown loam in the lower part. The underlying material, from 19 to 60 inches, is grayish brown loam in the upper part, yellowish brown loam in the middle part, and yellowish brown sandy clay loam in the lower part. In places, generally on tops of knolls and ridges, the surface layer is thinner.

Typically, the Emrick soil has a surface layer of black loam about 16 inches thick. The subsoil, from 16 to 34 inches, is very dark grayish brown loam. The underlying material, from 34 to 60 inches, is light olive brown loam in the upper and middle parts and olive brown loam in the lower part.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the poorly drained Tonka soil and the very poorly drained Parnell soil. They are in deep depressions.

The soils in this map unit have moderate permeability. Available water capacity is high, and runoff is slow to rapid. Susceptibility to soil blowing is low and to water erosion is low to high.

Most areas of these soils are used for range. The potential is poor for crops and windbreaks and fair for most engineering and recreational uses. The potential is good for range and very poor for wetland wildlife habitat. It is generally not feasible to cultivate these soils because of stoniness.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition. Environmental plantings for wildlife habitat, recreation, or beautification are feasible if the trees and shrubs are hand-planted. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. Removing large stones helps minimize the limitation for septic tanks, dwellings, and sewage lagoons. Sewage lagoons can be treated for seepage by sealing the bottom of the lagoon. Alternate sites are needed for sewage lagoons where areas have 7 to 9 percent slopes. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass VI.

125F—Heimdal-Esmond very stony loams, 9 to 40 percent slopes. This map unit consists of deep, rolling to very steep, well drained, very stony soils on glacial moraines and coulee breaks. On moraines, the drainageways extend to concave lower slopes and swales. The swales sometimes contain small deep depressions. Stones, mainly on hills and ridges, cover 3 to 15 percent of the surface. The Heimdal soil is on side slopes and is

35 to 50 percent of the map unit. The Esmond soil is on hilltops and ridges and is 30 to 45 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the Heimdal soil has a surface layer of black loam about 8 inches thick. The subsoil, from 8 to 19 inches, is very dark grayish brown loam in the upper part and dark brown or brown loam in the lower part. The underlying material, from 19 to 60 inches, is grayish brown loam in the upper part, yellowish brown loam in the middle part, and yellowish brown sandy clay loam in the lower part. In places, the underlying material has a higher clay content.

Typically, the Esmond soil has a surface layer of black loam about 9 inches thick. The underlying material, from 9 to 23 inches, is dark grayish brown and grayish brown loam. The underlying material, from 23 to 60 inches, is light olive brown loam. In places the underlying material has a higher clay content.

Included with these soils in mapping, and making up 10 to 20 percent of the map unit, are small areas of the moderately well drained Emrick soil, the very poorly drained Parnell soil, and the poorly drained Tonka soil. The Emrick soil has a thicker subsoil and surface layer and is in swales, on lower slopes, and in drainageways. The Parnell and Tonka soils are in depressions.

The soils in this map unit have moderate permeability. Available water capacity is high, and runoff is very rapid. Susceptibility to soil blowing is low and to water erosion is very high.

Most areas of these soils are used for range. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. The potential is good for range and is very poor for wetland wildlife habitat. It is generally not feasible to cultivate these soils because of stoniness and slope.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

Environmental plantings for wildlife habitat, recreation, or beautification are feasible if the trees and shrubs are hand-planted. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are poorly suited to sanitary facilities and buildings. Removal of large stones helps minimize the limitation for dwellings and septic tanks. Slope is a limitation for buildings that can be overcome by cut and fill operations in areas that have 9 to 15 percent slopes. Alternate sites are needed for sewage lagoons, dwellings, and septic tanks where areas have 15 to 40 percent slopes. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass VIIc.

126—Fram loam, saline, 1 to 3 percent slopes. This deep, nearly level, somewhat poorly drained, moderately saline soil is on glacial till plains. Individual areas of this map unit are 5 to 200 acres.

Typically, the surface layer is black loam in the upper part, very dark gray loam in the lower part, and about 13 inches thick. The next layer, from 13 to 27 inches, is grayish brown loam. The underlying material, from 27 to 60 inches, is light olive brown loam in the upper part and olive brown loam in the lower part. In places, particularly the southwestern part of the county, the surface layer to the underlying material is silt loam or very fine sandy loam. In other places, there is a higher clay content in the underlying material. In places, the soil is slightly saline or strongly saline. Elsewhere the soil is poorly drained and has a higher clay content from the surface layer through the underlying material.

Included with this soil in mapping, and making up 10 to 20 percent of the map unit, are small areas of the moderately well drained Cathay and Emrick soils, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Cathay soil contains excess sodium in the subsoil. The Emrick soil has no layers of lime accumulation within a depth of 16 inches. The Cathay and Emrick soils are on higher rises. The Tonka and Parnell soils are in deep depressions.

This Fram soil has moderate permeability. Available water capacity is moderate, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness. The high salt content restricts plant growth. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of this soil are used for cultivated crops, hay, and range. The potential is fair for crops, range, and wetland wildlife habitat. The potential is poor for windbreaks and for most engineering and recreational uses.

This soil is suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are wetness, salinity, and control of soil blowing. Adequate outlets for drainage water are often difficult to locate. Maintaining surface drains reduces the wetness. Planting saline-tolerant crops, avoiding summer fallow, and avoiding deep tillage reduce salinity. Intensive use of annual buffer strips and stubble mulching alleviate soil blowing.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to sanitary facilities and buildings. Wetness is a severe limitation that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. The salinity hinders landscaping. Alternate sites are needed for buildings and

related uses. This soil is suited to wetland wildlife habitat.

This map unit is in capability subclass IIIw.

127—Fram loam, 1 to 3 percent slopes. This deep, nearly level, somewhat poorly drained soil is on glacial till plains. Individual areas of this map unit are 5 to 200 acres.

Typically, the surface layer is black loam in the upper part and very dark gray loam in the lower part and is about 13 inches thick. The next layer, from 13 to 27 inches, is grayish brown loam. The underlying material, from 27 to 60 inches, is light olive brown loam in the upper part and olive brown loam in the lower part. In places, particularly the southwestern part of the county, the surface layer to the underlying material is silt loam or very fine sandy loam. In addition, in parts of this area the underlying material has higher clay content. In other places, the soil is poorly drained, and there is a higher clay content from the surface through the underlying material.

Included with this soil in mapping, and making up 10 to 20 percent of the map unit, are small areas of the moderately well drained Cathay and Emrick soils, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Cathay soil contains excess sodium in the subsoil. The Emrick soil has no layers of lime accumulation within a depth of 16 inches. The Cathay and Emrick soils are on higher rises. The Tonka and Parnell soils are in deep depressions.

This Fram soil has moderate permeability. Available water capacity is high, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of this soil are used for cultivated crops. The potential is good for crops, range, and windbreaks. The potential is fair for wetland wildlife habitat and is poor for most engineering and recreational uses.

This soil is well suited to wheat, oats, barley, flax, and grass-legume hay. Wetness and control of soil blowing are the main management concerns. Adequate outlets for drainage water are often difficult to locate. Maintaining surface drains and intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is poorly suited to sanitary facilities and buildings. Wetness is a severe limitation that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is suited to wetland wildlife habitat.

This map unit is in capability subclass IIw.

129—Colvin and Borup silt loams, saline. This map unit consists of deep, level, poorly drained, moderately saline soils on glacial lake plains, in drainageways, and adjacent to old stream channels. Any area can consist entirely of the Colvin soil or the Borup soil or any combination of the two soils. Individual areas of this map unit are 5 to 350 acres.

Typically, the surface layer of the Colvin soil is black silt loam in the upper part and very dark gray silt loam in the lower part and is about 12 inches thick. The underlying material, from 12 to 30 inches, is dark gray silty clay loam. The underlying material, from 30 to 60 inches, is dark gray silty clay loam in the upper part and olive gray and olive loam in the lower part. In places the surface layer is silty clay loam. In other places, generally in deeper swales, the soil is very poorly drained. Also in places the soil is slightly saline or strongly saline.

Typically, the surface layer of the Borup soil is black silt loam in the upper part and very dark gray silt loam in the lower part and is about 12 inches thick. The next layer, from 12 to 30 inches, is dark gray silt loam in the upper part and gray silt loam in the lower part. In places, generally in deeper swales, the soil is very poorly drained. In other places it is slightly saline or strongly saline.

Included with these soils in mapping, and making up as much as 10 percent of the map unit, are small areas of the poorly drained Fossum soil. It has a fine sandy loam surface layer and sandy underlying material and is in the same landscape position as the Colvin and Borup soils.

Permeability in the Colvin soil is moderately slow, available water capacity is high, and runoff is slow. Permeability in the Borup soil is moderately rapid, available water capacity is moderate, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. The high salt content restricts plant growth. Susceptibility to soil blowing is high.

Most areas of these soils are used for hay, pasture, and range. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. The potential is fair for range and good for wetland wildlife habitat.

These soils are poorly suited to wheat, oats, barley, flax, and grass-legume hay. When these soils are tilled, the main management concerns are wetness, salinity, and control of soil blowing. Adequate outlets for drainage water are often difficult to locate. Maintaining surface

drains reduces wetness. Planting saline-tolerant crops, avoiding summer fallow, and avoiding deep tillage reduce salinity. Intensive use of annual buffer strips and stubble mulching alleviate soil blowing.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The soils in this map unit are poorly suited to sanitary facilities and buildings. Wetness is a severe limitation that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. The salinity hinders landscaping. Alternate sites are needed for building and related uses. These soils are well suited to wetland wildlife habitat.

This map unit is in capability subclass IVw.

131D—Miranda Variant loam, 3 to 15 percent slopes. This deep, undulating to rolling, moderately well drained and somewhat poorly drained soil is on coulee side slopes and foot slopes. Individual areas of this map unit are 5 to 200 acres.

Typically, the surface layer is black loam about 1 inch thick. The subsoil, from 1 inch to 13 inches, is dense silty clay. The upper part is black and the lower part is very dark grayish brown. The underlying material, from 13 to 42 inches, is silty clay and is dark grayish brown in the upper part and olive gray in the middle and lower parts. Below a depth of 42 inches is weathered shale bedrock. In places the subsoil is less dense. In other places the surface is stony, and in places the soil is strongly saline.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the moderately well drained Darnen soil and the well drained Esmond soil. These soils do not have a dense subsoil. The Darnen soil is in draws and on fans. The Esmond soil is on higher convex slopes.

This Miranda soil has very slow permeability. Available water capacity is moderate and high, and runoff is medium to very rapid. The surface is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing is low and to water erosion is moderate to very high.

Most areas of this soil are used for range. The potential is poor for crops, windbreaks, and for most recreational uses. The potential is fair for range and most engineering uses and is very poor for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of excess sodium, salinity, and restricted root growth.

This soil is best suited to pastureland or rangeland. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases sur-

face runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is suited to buildings and sanitary facilities. The very slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. The excess sodium and salinity hinder landscaping. Better suited sites for septic tanks and buildings are generally nearby. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass VI.

133—Fordville loam, 1 to 3 percent slopes. This deep, nearly level, well drained soil is on stream terraces and glacial outwash plains, and is moderately deep over sand and gravel. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the surface layer is very dark gray loam about 10 inches thick. The subsoil, from 10 to 20 inches, is very dark grayish brown loam in the upper part and dark brown loam in the lower part. The underlying material, from 20 to 60 inches, is dark grayish brown coarse sandy loam in the upper part, grayish brown sand and gravel in the middle part, and dark grayish brown sand and gravel in the lower part. In places the soils are gently sloping.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the somewhat excessively drained Renshaw soil. This soil is shallow over sand and gravel and is on the higher rises.

This soil has moderate permeability in the upper part and rapid permeability in the underlying material. Available water capacity is low, and runoff is slow. Susceptibility to soil blowing and to water erosion is low.

Most areas of this soil are used for cultivated crops. The potential is good for range, windbreaks, and for most engineering and recreational uses. The potential is fair for crops and is very poor for wetland wildlife habitat.

This soil is suited to wheat, oats, barley, flax, and grass-legume hay. Low available water capacity is the main management concern. High stubble and stubble mulching can alleviate this limitation.

This soil is well suited to pastureland or rangeland. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing nearly all climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIs.

134—Borup-Vallers complex, 1 to 3 percent slopes.

This map unit consists of deep, nearly level, poorly drained soils on glacial lake plains. The Borup soil is on foot slopes and is 35 to 60 percent of the map unit. The Vallers soil is on side slopes and is 30 to 55 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 150 acres.

Typically, the surface layer of the Borup soil is silt loam about 12 inches thick. It is black in the upper part and very dark gray in the lower part. The underlying material, from 12 to 30 inches, is dark gray and gray silt loam. The underlying material, from 30 to 60 inches, is grayish brown silt loam and olive brown very fine sandy loam. In places, 1 to 10 percent of the surface is covered by stones.

Typically, the Vallers soil has a surface layer of black loam about 9 inches thick. The underlying material, from 9 to 22 inches, is gray and olive gray clay loam. From 22 to 60 inches it is olive gray and gray clay loam in the upper part and gray clay loam in the lower part.

Included with these soils in mapping, and making up as much as 10 percent of the map unit, are small areas of the very poorly drained Rauville soil on the wetter seep areas.

Permeability in the Borup soil is moderately rapid, available water capacity is high, and runoff is slow. Permeability in the Vallers soil is moderately slow, available water capacity is high, and runoff is slow. In spring and after heavy rainy periods, wetness results from seepage. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of these soils are used for native range, pasture, and hayland. The potential is good for range, windbreaks, and wetland wildlife habitat. The potential is poor for crops and for most engineering and recreational uses. It is generally not feasible to cultivate these soils because of wetness resulting from nearly continuous seepage.

Using these soils for pastureland or rangeland helps control erosion: Overgrazing or grazing when the soil is wet causes surface compaction, decreases water infiltration, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

If drained, these soils are well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow

well. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings. Undrained areas are not suited to these uses.

The soils in this map unit are poorly suited to sanitary facilities and buildings. Wetness from nearly continuous seepage is a severe limitation. Alternate sites are needed for buildings and related uses. These soils are well suited to wetland wildlife habitat.

This map unit is in capability subclass Vw.

135—Miranda-Larson complex, 1 to 3 percent slopes. This map unit consists of deep, nearly level, moderately well drained and somewhat poorly drained soils on stream bottom lands and in small basins or flats on glacial till plains. The Miranda soil is in micro depressions and is 35 to 55 percent of the map unit. The Larson soil is in swales and on slopes and is 30 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 200 acres.

Typically, the Miranda soil has a surface layer of black loam or clay loam about 3 inches thick. The subsurface layer, from 3 to 5 inches is very dark gray loam. The subsoil, from 5 to 22 inches, is dense clay loam and is very dark gray in the upper part, black and very dark gray in the middle part, and very dark grayish brown in the two lower parts. The underlying material, from 22 to 60 inches, is clay loam and is dark grayish brown in the upper part and olive brown in the lower part. In places, the soil has lower clay content.

Typically, the Larson soil has a surface layer of black loam about 6 inches thick. The subsurface layer, from 6 to 7 inches, is very dark gray loam. The subsoil, from 7 to 20 inches, is dense clay loam and is very dark brown in the upper part and very dark grayish brown in the middle and lower parts. The underlying material, from 20 to 60 inches, is clay loam and is light brownish gray in the upper part, grayish brown in the middle part, and light olive brown in the lower part. In places, the subsoil is less dense.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the very poorly drained Parnell soil and the poorly drained Tonka and Vallers soils. The Vallers soil has layers of lime accumulation within a depth of 16 inches around the margins of deep depressions. In places, this soil is moderately saline. The Parnell and Tonka soils are in deep depressions.

Permeability of the Miranda soil is very slow, available water capacity is moderate or high, and runoff is slow. Permeability of the Larson soil is slow, available water capacity is moderate, and runoff is slow. The surface is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing and to water erosion is low.

Most areas of these soils are used for range. The potential is poor for crops, range, and windbreaks. The potential is very poor for wetland wildlife habitat and is fair for most engineering and recreational uses. It is generally not feasible to cultivate these soils because of excess sodium, salinity, and restricted root growth.

These soils are best suited to pastureland or rangeland. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The soils in this map unit are suited to sanitary facilities and buildings. The very slow permeability is a limitation for septic tanks that can be overcome by increasing the size of the absorption field. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. The excess sodium and salinity hinder landscaping. Better suited sites for septic tanks and buildings are generally nearby. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass Vls.

137—Stirum loamy fine sand. This deep, level, poorly drained soil is on glacial outwash and lake plains. Individual areas of this map unit are 5 to 100 acres.

Typically, the surface layer is black loamy fine sand about 8 inches thick. The subsurface layer, from 8 to 9 inches, is black loamy fine sand. The subsoil, from 9 to 18 inches, is dense, very dark gray, fine sandy loam. The underlying material, from 18 to 60 inches, is loamy fine sand and is olive gray in the upper and lower parts and olive in the middle part. In places, the surface layer is fine sandy loam or loam. In other places, there is sand and gravel beginning at a depth of 20 to 40 inches.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of the moderately well drained Hecla and Letcher soils. The Hecla soil does not have a dense subsoil and is on some higher swells. The Letcher soil is better drained and is in the same landscape position as the Stirum soil.

This Stirum soil has moderately slow permeability. Available water capacity is moderate, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. The surface is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing is very high.

Most areas of this soil are used for cultivated crops, hay, and pasture. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. The potential is fair for range and wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. When this soil is tilled, the main management concerns are wetness, improving soil tilth,

and controlling soil blowing. Adequate outlets for drainage water are often difficult to locate. Maintaining surface drains can alleviate wetness. Use of crop residue, green manure crops, and deep plowing to break up the dense subsoil can reduce the soil tilth condition. Intensive use of annual buffer strips and stubble mulching help control soil blowing.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to sanitary facilities and buildings. Wetness and flooding are severe limitations that can be overcome in part by drainage; however, adequate outlets are difficult to locate. Alternate sites are needed for buildings and related uses. This soil is suited to wetland wildlife habitat.

This map unit is in capability subclass IVw.

140B—Svea-Buse loams, 3 to 6 percent slopes.

This map unit consists of deep, undulating soils on glacial till plains and moraines. The moderately well drained Svea soil is in swales and on concave lower slopes, and is 40 to 50 percent of the map unit. The well drained Buse soil is on upper slopes and tops of knolls and is 40 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 600 acres.

Typically, the Svea soil has a surface layer of black loam about 12 inches thick. The subsoil, from 12 to 22 inches, is very dark grayish brown loam in the upper part and dark grayish brown loam in the lower part. The underlying material, from 22 to 60 inches, is grayish brown loam.

Typically, the Buse soil has a surface layer of very dark gray loam about 8 inches thick. The underlying material, from 8 to 15 inches, is grayish brown loam. The underlying material, from 15 to 60 inches, is light olive brown loam. In places, generally on side slopes, there is a subsoil. In other places, generally on higher knolls, the surface layer is thinner and moderately eroded.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the somewhat poorly drained Hamerly soil, the very poorly drained Parnell soil, and the poorly drained Tonka and Vallery soils. The Hamerly and Vallery soils are around the margins of deep depressions and have layers of lime accumulation within a depth of 16 inches. The Parnell and Tonka soils are in deep depressions.

The soils in this map unit have moderately slow permeability. Available water capacity is high, and runoff is medium. Susceptibility to soil blowing is low and to water erosion is moderate.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, and recre-

ational uses. The potential is very poor for wetland wildlife habitat and is fair for windbreaks and most engineering uses.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. Maintaining good soil tilth and controlling water erosion are the main management concerns. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Svea soil is well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well. The Buse soil is poorly suited to trees and shrubs in windbreaks and environmental plantings, but is suited to plantings for wildlife habitats, recreation, and beautification where survival, growth, and vigor are not required or expected to be optimum. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. The wetness limitation for buildings on the Svea soil can be minimized by foundation drainage or by locating structures on the high lying Buse soil. The shrink-swell potential is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIe.

141—Embden-Letcher fine sandy loams, 1 to 3 percent slopes. This map unit consists of deep, nearly level, moderately well drained soils on glacial outwash plains. The Embden soil is on rises and is 50 to 60 percent of the map unit. The Letcher soil is in swales and is 40 to 50 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 200 acres.

Typically, the Embden soil has a surface layer of black fine sandy loam about 12 inches thick. The subsoil, from 12 to 34 inches, is fine sandy loam and is very dark grayish brown in the upper part and dark brown in the lower part. The underlying material, from 34 to 60 inches, is brown loamy fine sand. In places, the Embden soil is gently sloping.

Typically, the Letcher soil has a surface layer of black fine sandy loam about 9 inches thick. The subsurface layer, from 9 to 10 inches, is dark grayish brown loamy fine sand. The subsoil, from 10 to 23 inches, is dense

fine sandy loam and is dark grayish brown in the upper part and brown in the lower part. The underlying material, from 23 to 60 inches, is light olive brown and is fine sandy loam in the upper part, loam in the middle part, and sand in the lower part. In places, the combined thickness of the surface and subsurface layers is 5 inches or less.

Permeability in the Embden soil is moderately rapid, available water capacity is moderate, and runoff is slow. Permeability in the Letcher soil is slow in the subsoil and moderately rapid in the underlying material. Available water capacity is moderate, and runoff is slow. The surface in areas of the Letcher soil is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing is high.

Most areas of these soils are used for cultivated crops. The potential is fair for crops, windbreaks, and for most engineering uses. The potential is poor for wetland wildlife habitat and good for range and recreational uses.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are improving soil tilth in areas of the Letcher soil and controlling soil blowing. Use of crop residue, green manure crops, and deep plowing to break up the dense subsoil help improve soil tilth. Intensive use of field windbreaks, annual buffer strips, and stubble mulching help control soil blowing.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing results in reduced plant vigor and forage yields. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Embden soil is well suited to trees and shrubs in windbreaks and environmental plantings. All climatically adapted species have the potential to grow well. The Letcher soil is generally not suited to trees and shrubs in windbreaks and environmental plantings because of excess sodium and restricted root growth. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are suited to sanitary facilities and buildings. The slow permeability is a limitation for septic tanks on the Letcher soil and can be overcome by increasing the size of the absorption field. There is a possibility of septic tank effluent contaminating ground water supplies because of the high seepage rates. Wetness is a limitation for buildings that can be minimized by foundation drainage. Alternate sites are needed for sewage lagoons. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

144—Hamerly-Cresbard loams, 1 to 3 percent slopes. This map unit consists of deep, nearly level soils on glacial till plains. The somewhat poorly drained Ha-

merly soil is in swales, on concave slopes of rises, and is 50 to 80 percent of the map unit. The moderately well drained Cresbard soil is on slopes of rises, is slightly above the Hamerly soil, and is 20 to 40 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 300 acres.

Typically, the surface layer of the Hamerly soil is loam about 9 inches thick. It is black in the upper part and very dark gray in the lower part. The underlying material, from 9 to 22 inches, is grayish brown and brown clay loam. The underlying material, from 22 to 60 inches, is light olive brown loam.

Typically, the Cresbard soil has a surface layer of very dark gray loam about 6 inches thick. The subsurface layer, from 6 to 8 inches, is dark grayish brown loam. The subsoil, from 8 to 16 inches, is dense silty clay and is dark grayish brown in the upper part and very dark grayish brown in the lower part. The underlying material, from 16 to 60 inches, is olive brown clay loam in the upper part and dark grayish brown clay loam in the lower part.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the poorly drained Tonka soil and the very poorly drained Parnell soil. The Tonka and Parnell soils are in deep depressions.

Permeability in the Hamerly soil is moderately slow, available water capacity is high and runoff is slow. Permeability in the Cresbard soil is slow, available water capacity is moderate, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. The surface in areas of the Cresbard soil is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of these soils are used for cultivated crops. The potential is good for crops, range, and windbreaks. The potential is fair for recreational uses and is poor for most engineering uses and wetland wildlife habitat.

These soils are well suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are maintaining good soil tilth and controlling soil blowing. Use of crop residue and intensive use of field windbreaks, annual buffer strips, and stubble mulching can alleviate these limitations.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Hamerly soil is well suited to trees and shrubs in windbreaks and environmental plantings, and all climatically adapted species have the potential to grow well on the Hamerly soil. The Cresbard soil is suited to trees and shrubs in windbreaks and environmental plantings. Many climatically adapted species have the potential to grow well on the Cresbard soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are poorly suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings on the Hamerly soil and can be minimized by foundation drainage. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. These soils are poorly suited to wetland wildlife habitat.

This map unit is in capability subclass IIIs.

144B—Hamerly-Cresbard loams, 3 to 6 percent slopes. This map unit consists of deep, gently sloping soils on glacial till plains. The somewhat poorly drained Hamerly soil is in swales, on the concave lower slopes, and is 50 to 80 percent of the map unit. The moderately well drained Cresbard soil is on lower slopes, is slightly above the Hamerly soil, and is 20 to 40 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 125 acres.

Typically, the surface layer of the Hamerly soil is loam about 9 inches thick. It is black in the upper part and very dark gray in the lower part. The underlying material, from 9 to 22 inches, is grayish brown and brown clay loam. The underlying material, from 22 to 60 inches, is light olive brown loam.

Typically, the Cresbard soil has a surface layer of very dark gray loam about 6 inches thick. The subsurface layer, from 6 to 8 inches, is dark grayish brown loam. The subsoil, from 8 to 16 inches, is dense silty clay and is dark grayish brown in the upper part and very dark grayish brown in the lower part. The underlying material, from 16 to 60 inches, is olive brown clay loam in the upper part and dark grayish brown clay loam in the lower part.

Included with these soils in mapping, and making up 15 to 20 percent of the map unit, are small areas of the well drained Barnes soil, the moderately well drained Svea soil, the poorly drained Tonka soil, and the very poorly drained Parnell soil. The Barnes and Svea soils are on knolls and side slopes. The Tonka and Parnell soils are in deep depressions.

Permeability in the Hamerly soil is moderately slow, available water capacity is high, and runoff is medium. Permeability in the Cresbard soil is slow, available water

capacity is moderate, and runoff is medium. Early in spring and after unusually heavy rainy periods there is surface ponding in areas of the Cresbard soil. The surface in areas of the Cresbard soil is hard and crusted when dry and dispersed when wet. The dense subsoil restricts the rooting depth of plants. Susceptibility to soil blowing is high and to water erosion is moderate.

Most areas of these soils are used for cultivated crops. The potential is good for range and windbreaks and is fair for crops and recreational uses. The potential is very poor for wetland wildlife habitat and poor for most engineering uses.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are maintaining good soil tilth and controlling soil blowing and water erosion. Use of crop residue helps maintain good soil tilth. Intensive use of field windbreaks, annual buffer strips, and stubble mulching helps alleviate soil blowing. Use of crop residue and planting of grassed waterways where necessary help control water erosion.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

The Hamerly soil is well suited to trees and shrubs in windbreaks and environmental plantings, and all climatically adapted species have the potential to grow well on the Hamerly soil. The Cresbard soil is suited to trees and shrubs in windbreaks and environmental plantings. Many climatically adapted species have the potential to grow well on the Cresbard soil. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are poorly suited to sanitary facilities and buildings. The moderately slow permeability is a limitation for septic tanks and can be overcome by increasing the size of the absorption field. Wetness is a limitation for buildings on the Hamerly soil that can be minimized by foundation drainage. Shrink-swell is a limitation for buildings that can be overcome by reinforcing foundations and basement walls. These soils are generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IIIe.

145—Grano silty clay, saline. This deep, level, poorly drained and very poorly drained, moderately saline soil is on glacial lake plains. Individual areas of this map unit are 5 to more than 600 acres.

Typically, the surface layer is black silty clay about 10 inches thick. The underlying material, from 10 to 60 inches, is very dark gray and dark gray clay in the upper part, dark gray clay in the middle part, and olive gray clay in the lower part. In places, layers of lime accumulation are within a depth of 16 inches. In other places, the

surface layer is more than 10 inches thick, and there is a subsoil. In addition, in places the soil is slightly saline or strongly saline.

This soil has slow permeability. Available water capacity is moderate, and runoff is slow. Early in spring and after unusually heavy rainy periods a high water table develops, resulting in wetness and some surface ponding. The high salt content restricts plant growth. Susceptibility to soil blowing is high.

Most areas of this soil are used for hay, pasture, and range. The potential is poor for crops, windbreaks, and for most engineering and recreational uses. The potential is fair for range and is good for wetland wildlife habitat. It is generally not feasible to cultivate this soil because of wetness, salinity (fig. 11), and the high hazard of soil blowing.

Using this soil for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet reduces surface infiltration and causes surface compaction and poor soil tilth. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is poorly suited to sanitary facilities and buildings. Wetness is a severe limitation that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. The salinity hinders landscaping. Alternate sites are needed for buildings and related uses. This soil is well suited to wetland wildlife habitat.

This map unit is in capability subclass VIc.

146—Hamerly-Tonka loams, 0 to 3 percent slopes.

This map unit consists of deep, level and nearly level soils on glacial till plains. The somewhat poorly drained Hamerly soil is on convex slopes between depressions, on margins of depressions, and is 60 to 80 percent of the map unit. The poorly drained Tonka soil is in depressions and is 10 to 30 percent of the map unit. Areas of the two soils are so intricately mixed or individually so small in size that it is not practical to separate them in mapping. Individual areas of this map unit are 5 to 600 acres.

Typically, the surface layer of the Hamerly soil is black loam in the upper part, very dark gray loam in the lower part, and is about 9 inches thick. The underlying material, from 9 to 22 inches, is grayish brown and brown clay loam. The underlying material, from 22 to 60 inches, is light olive brown loam. In places, generally on the margins of depressions, the soil is poorly drained and some of the soil is moderately saline. In other places, the slopes of the Hamerly soil are gently sloping.

Typically, the Tonka soil has a surface layer of black loam about 14 inches thick. The subsurface layer, from 14 to 22 inches, is dark gray silt loam. The subsoil, from 22 to 52 inches, is very dark grayish brown silty clay in the upper part and olive gray silty clay loam in the lower part. The underlying material, from 52 to 60 inches, is



Figure 11.—On Grano saline soils the salinity affects crop emergence, growth, and yield.

olive gray silty clay loam. In places, the surface layer is silt loam.

Included with these soils in mapping, and making up as much as 15 percent of the map unit, are small areas of the well drained Barnes soil, the very poorly drained Parnell soil, and the moderately well drained Svea soil. The Barnes and Svea soils are better drained, are on higher slopes, and are above the Hamerly soil. The Parnell soil does not have a light colored subsurface layer and is in the deeper part of the depressions.

Permeability in the Hamerly soil is moderately slow, available water capacity is high, and runoff is slow or ponded. Permeability in the Tonka soil is slow, available water capacity is high, and runoff is slow or ponded. Early in spring and after heavy rainy periods a high water table develops, resulting in wetness and some surface ponding, particularly in areas of the Tonka soil. Susceptibility to soil blowing is high and to water erosion is low.

Most areas of these soils are used for cultivated crops. The potential is good for range, windbreaks, and wetland wildlife habitat. The potential is fair for crops and is poor for most engineering and recreational uses.

These soils are suited to wheat, oats, barley, flax, and grass-legume hay. The main management concerns are wetness, surface ponding, and control of soil blowing. Adequate outlets for drainage water are often difficult to locate. Maintaining surface drains and intensive use of field windbreaks, annual buffer strips, and stubble mulching help alleviate these limitations.

Using these soils for pastureland or rangeland helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, reduces soil tilth, and increases surface runoff. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

These soils are suited to trees and shrubs in windbreaks and environmental plantings. Undrained areas of the Tonka soil are not suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing all climatically adapted species. Grass and weeds need to be eliminated, and ground cover regrowth needs to be controlled for the entire life of the plantings.

The soils in this map unit are poorly suited to sanitary facilities and buildings. Wetness and flooding are severe limitations that can be overcome in part by drainage; however, adequate outlets for drainage water are difficult to locate. Alternate sites are needed for buildings and related uses. These soils are well suited to wetland wildlife habitat.

This map unit is in capability subclass IIIw.

149B—Maddock loamy fine sand, 1 to 6 percent slopes. This deep, nearly level and gently sloping, well drained soil is on sandy plains. Individual areas of this map unit are 5 to more than 400 acres.

Typically, the surface layer is very dark gray loamy fine sand about 12 inches thick. The subsoil, from 12 to 21 inches, is dark brown loamy fine sand. The underlying material, from 21 to 60 inches, is dark brown fine sand in the upper part and dark grayish brown fine sand in the lower part. In places, generally on the tops of knolls and ridges, the surface layer is thinner and moderately eroded with a few small blowout spots.

Included with this soil in mapping, and making up as much as 15 percent of the map unit, are small areas of

the moderately well drained Hecla soil. This soil has a thicker surface layer and is in swales.

This Maddock soil has rapid permeability. Available water capacity is low, and runoff is slow. Susceptibility to soil blowing is very high and to water erosion is low.

Most areas of this soil are used for range. The potential is fair for range, windbreaks, and recreational uses. The potential is good for most engineering uses, is poor for crops, and is very poor for wetland wildlife habitat.

This soil is poorly suited to wheat, oats, barley, flax, and grass-legume hay. If these soils are tilled, the main management concerns are low available water capacity and control of soil blowing. High stubble, intensive use of field windbreaks, annual buffer strips, and stubble mulching help alleviate these limitations.

Using this soil for pastureland or rangeland helps control erosion. Conserving soil moisture and overgrazing are the main management concerns. Proper stocking rates, pasture rotation, and timely delay of grazing help keep the pasture and soil in good condition.

This soil is suited to trees and shrubs in windbreaks and environmental plantings. Potential is good for growing some climatically adapted species. Grass and weeds need to be eliminated before the trees are planted, and ground cover regrowth needs to be controlled for the entire life of the plantings.

This soil is well suited to sanitary facilities and buildings. There is a possibility of septic tank effluent contaminating groundwater supplies because of the high seepage rates. Alternate sites are needed for sewage lagoons. This soil is generally not suited to wetland wildlife habitat.

This map unit is in capability subclass IVe.

150—Pits, gravel. Most areas of this map unit are not used for any particular purpose other than mining the remaining sand and gravel. Potential is poor for crops, range, windbreaks, most engineering and recreational uses, and wetland wildlife habitat.

These areas are generally not suited to agricultural uses unless they are reclaimed by leveling and adding topdressing with suitable topsoil material. On unreclaimed areas, climatically adapted trees and shrubs can be planted on pit bottoms for wildlife habitat and for aesthetic value.

These areas are generally not suited to most engineering uses unless they are level and reclaimed. Drainage outlets need to be provided for ponded areas and places having a seasonal high water table. Onsite investigations are needed to evaluate these materials for specific uses, such as sanitary facilities and building sites.

These areas are generally not suited to most recreational uses unless they are reclaimed by leveling and topdressing with suitable topsoil material. They are generally not suited to wetland wildlife habitat except in areas that have a seasonal high water table.

This map unit is in capability subclass VIIIs.

Use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and pasture

Edward R. Weimer, agronomist, Soil Conservation Service, helped prepare this section.

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, plan-

ners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

In 1967, more than 672,000 acres in the Benson County Area was used for crops and pasture, according to the North Dakota Conservation Needs Inventory of July, 1970. Of this total, 42,000 acres was used for pasture; 3,450 acres for row crops, mainly corn; 349,600 acres for close-grown crops, mainly wheat, barley, oats and flax; and 174,000 acres for summer fallow. Since 1967, the acreage in close-grown crops has increased, and the acreage in pasture, row crops, and summer fallow has decreased, mainly because of higher grain prices and changes in agricultural programs.

Potential is good in the Benson County Area for increased production of food and fiber. Extending the latest crop production technology to all cropland in the county helps increase production. This soil survey facilitates the application of this technology.

The main management needs for use of the soils in the Benson County Area are controlling soil blowing and water erosion, conserving moisture, and maintaining fertility.

Soil blowing is a hazard on nearly all soils in the survey area, but it is most severe on the sandy Dickey, Egeland, Embden, Hecla, Maddock, and Towner soils. It can damage these soils in a very short time if winds are strong and the soils are dry and bare of vegetation or surface mulch. Water erosion is a hazard mainly on the gently rolling and steeper soils such as the Barnes, Buse, Esmond, and Heimdal soils. Measures that help to control soil blowing and water erosion are use of cover crops, strip crops, buffer strips, windbreaks, contour tillage, diversions and waterways, minimum tillage, timely and emergency tillage, grasses and legumes in the cropping system, and crop residue. A combination of several measures is generally used.

Moisture is generally conserved by reducing evaporation, limiting runoff, increasing infiltration, and controlling weeds. Some effective management practices are stubble mulching, contour tillage, strip cropping, field windbreaks and buffer strips, timely and minimal tillage, grasses and legumes grown in the cropping system, crop residue maintained on the surface, and fertilizer. Periods of fallow help to control weeds and store available moisture in the soil.

Among the measures that help to maintain fertility are the application of fertilizer; the plowing down of green manure and barnyard manure; the inclusion of cover crops, grasses, and legumes in the cropping system; and the use of summer fallow. Most measures used to control soil blowing and water erosion also help to maintain fertility.

Artificial drainage, stone removal, and reduction of salinity help offset the effects of unfavorable soil characteristics. Draining soils that are somewhat poorly drained to very poorly drained can increase yields and the choice of crops. Many areas, however, do not have suitable outlets. Some stone removal is usually necessary on soils that formed in glacial till, such as the Esmond, Heimdal, and Barnes soils. Saline soils benefit from the elimination of summer fallow and the growth of the most salt-tolerant grain crops, green manure crops, and tame and native grasses.

The most commonly used conservation practices, such as growing green manure crops and including grasses and legumes in the cropping system, help maintain good soil tilth. Heavy textured soils, such as Fargo and Hegne, are often plowed in fall at the right moisture content to maintain tilth and to prepare a good seedbed.

Some crops commonly grown and suited to the soils and climate of the county are wheat, barley, oats, flax, rye, legumes, and tame grasses. Crops not commonly grown, but suitable, are potatoes, sunflowers, buckwheat, and dry edible beans such as pinto beans. The acreage of sunflowers is increasing.

Information and specifications on practices and crops described in this section can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or

cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Rangeland

H. Dee Galt, range conservationist, Soil Conservation Service, prepared this section.

About 12 percent of Benson County Area is rangeland. The main areas of rangeland are located along the Sheyenne River valley in the southwestern part of the survey area, in the western part, and adjacent to Devils Lake in the southeastern part. These lands are generally best suited to grazing or hay because of shallow soil depths, excess stoniness, steepness of slope, coarse sandy soils, or wet soils.

Most of the livestock operations are combined with grain farming. The most common livestock operation is cow-calf-yearling. The yearlings are usually fed hay and grain raised on the farm. Livestock operations vary in size depending on the amount of grazing and hayland available. An average size livestock-grain unit is about 1,500 acres. Introduced pastures of smooth brome or crested wheatgrass are used for spring grazing on some enterprises. The cattle herds are grazed on rangeland and pastureland during spring, summer, and fall. Cattle are brought to the farmsteads about December for the winter feeding period which lasts until April or May.

About 54 percent of the rangelands need improvement, according to the 1970 Conservation Needs Inventory conducted by the Soil Conservation Service. Ranges that have been depleted by continued heavy grazing produce only about one-third of their potential. The taller grasses have been replaced by short grasses and weedy plants. Productivity can be increased by range management or a combination of management and range improvement practices, such as brush control, range seeding, or mechanical treatment.

In the northwestern part of the county, deep sandy soils have a moderate to severe hazard of soil blowing. Most of these soils are best suited to grasslands. Most of the lowlands associated with Devils Lake are very wet during spring and early in summer, which limits their use for grazing and haying. Grazing during spring and early in summer causes depletion of native vegetation from trampling. Much of the land adjacent to Devils Lake is

woodland. About one-third of the wooded area is grazed by cattle and produces good quality summer forage.

The main management concern on most of the rangeland is control of grazing to maintain or improve the kinds and amounts of plants making up the potential plant community. Poor management results in soil blowing and invasion of brush or other weedy plants on rangelands. Potential is good for increasing productivity of the range, if sound range management based on the rangeland inventories and soil survey information is applied.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil in the survey area, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be

used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Windbreaks and environmental plantings

Elmer R. Umland, forester, Soil Conservation Service, assisted in preparing this section.

There are approximately 14,000 acres of native woodland in the survey area. About 12,500 acres of woodland grows on the Aastad and Bottineau soils and the Edgeley variant soils on the slopes adjacent to Devils Lake (5). The Edgeley variant soils support an almost pure stand of bur oak. The Aastad, Bottineau, Barnes, and Buse soils are under the 1,100 acres of native woodland in the Wood Lake area. The 300 acres of native woodland around Pleasant Lake grows mainly on Maddock, Hecla, and Fossum soils. The remaining 400 acres of woodland is in the Sheyenne River valley and grows principally on Esmond, Heimdal, and Darnen soils.

The principal species of trees and shrubs in the Devils Lake and Wood Lake areas consist of bur oak, green ash, basswood, chokecherry, hawthorn, wild plum, silverberry, snowberry, currant, dogwood, Woods rose, junberry, buffaloberry, cottonwood, willow, and aspen. In the Pleasant Lake area they are American elm, green ash, bur oak, chokecherry, hawthorn, and buffaloberry; and in the Sheyenne Valley they are wild plum, chokecherry, green ash, and shrub willows.

The early settlers used trees for lumber, fence posts, and fuel. Now, trees and shrubs are mainly used for erosion control, livestock protection, wildlife habitat, recreation, aesthetic purposes, watershed protection, and for protection of homes, gardens, and crops.

Windbreaks have been planted in Benson County Area since the days of the early settlers. Most of these early plantings were used for farmstead and feedlot protec-

tion. Tree plantings are still needed around many farmsteads; however, the major need for windbreaks is in cultivated areas where the hazard of soil blowing is serious.

Items to be considered before planting a windbreak are the purpose of the planting, suitability of the soils, adaptability of the windbreak, and selection of a source of hardy trees and shrubs of the adaptable species. Poor soils, poor tree and shrub stock, and improper design result in unsatisfactory windbreaks.

The establishment of a windbreak and the growth of the trees and shrubs also depend upon the suitable preparation of the site and the adequate maintenance after the trees are planted. Grass and weeds need to be eliminated before the planting is made, and the regrowth of ground cover needs to be controlled throughout the life of the windbreak. Some replanting of the trees and shrubs is necessary during the first and second years after planting.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Engineering

Owen J. Kvittem, engineer, Soil Conservation Service, assisted in writing this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary

facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building site development

Table 8 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are *minor* and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary facilities

Table 9 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 9 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 9 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 9 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a

landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction materials

Table 10 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 10, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water management

Table 11 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones,

slope, and the hazard of cutbanks. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Recreation

James R. Thompson, resource conservation and development coordinator, Soil Conservation Service, helped prepare this section.

Most of the recreational developments in the survey area are in municipal or town parks and are adjacent to Devils Lake. Picnic sites are available at Leeds, Esmond, Maddock, Minnewaukan, Pleasant Lake, and Sully's Hill. No privately developed camping areas are in the survey area. Public trails and paths are provided at Sully's Hill.

State-owned tracts totaling 1,430 acres and 7,850 acres are managed by the Department of the Interior. They are the only public lands available in the survey area for public use. They provide for such activities as hiking, nature study, birding, and hunting. Public access to fishing waters is available.

The soils of the survey area are rated in table 12 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not consid-

ered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 12, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 12 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 9 and interpretations for dwellings without basements and for local roads and streets in table 8.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moder-

ate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife habitat

James E. Schmidt, biologist, Soil Conservation Service, helped prepare this section.

Hunting and fishing are important to the economy of the Benson County Area.

The numbers of wildlife have been reduced substantially since pre-settlement of the area, but the kinds are similar, and habitat is available for a wide variety of species. The development and management of fisheries helped increase fishing opportunities.

The most important game species in Benson County Area are ducks; geese for hunting populations and not as breeders; gray partridge; sharp-tailed grouse; and white-tailed deer. There are few pheasant. Mourning dove, cottontail, and fox squirrel are underutilized as game species. Red fox, jackrabbit, muskrat, and mink are important furbearers.

Popular non-game species of wildlife are songbirds, mourning doves, meadowlarks, raptors, marsh hawks, owls, shore birds, snipes, and curlews.

Using wetlands as defined by Circular 39, Wetlands of the United States, Fish and Wildlife Service, U.S. Department of the Interior, Tonka silt loam supports vegetation associated with Wetland Type 1; Parnell silty clay loam, Wetland Type 3; and Parnell and Lallie soils, ponded Wetland Type 4. Included in the water areas shown on the soil map are Wetland types 5 and 10. These are inland open freshwater and inland saline marshes. All wetland types are important to the production of water fowl and other water related wildlife.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 13, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specif-

ic elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, sunflower, rye, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are tall wheatgrass, slender wheatgrass, brome grass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, wheatgrass, indiagrass, and grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are chokecherry, juneberry, snowberry, and silverberry.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the

surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, cattail, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, and shrubs. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include gray partridge, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, redwing blackbirds, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include white-tailed deer, grouse, raptors, meadowlark, and lark bunting.

Soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering index properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (2) and the system adopted by the American Association of State Highway and Transportation Officials (1).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at

25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration; and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a

seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate, or high*, is based on soil drainage class,

total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate, or high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (8). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (9). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Soil maps for detailed planning."

Aastad series

The Aastad series consists of deep, moderately well drained soils on glacial till plains and moraines. Permeability of these soils is moderately slow. These soils formed in loamy glacial till. Slope is 3 to 6 percent.

Aastad soils are similar to the Svea soils and are near the Barnes, Bottineau, Edgeley variant, and Svea soils. The Barnes and Bottineau soils have a mollic epipedon less than 16 inches thick. Edgeley variant soils formed in a thin layer of glacial till or glaciofluvial deposits overlying shale bedrock. Svea soils have less clay in the solum.

Typical pedon of Aastad loam, from an area of Aastad-Bottineau loams, 3 to 6 percent slopes, 2,600 feet south and 1,420 feet east of the northwest corner of sec. 13, T. 152 N., R. 65 W.

A11—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate very fine granular; hard, friable, slightly sticky, and slightly plastic; about 2 percent pebbles; neutral; clear smooth boundary.

A12—8 to 18 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to moderate very fine subangular blocky; hard, friable, slightly sticky, and slightly pastic; about 2 percent pebbles; neutral; clear wavy boundary.

B21—18 to 22 inches; very dark grayish brown (2.5Y 3/2) clay loam, dark grayish brown (2.5Y 4/2) dry; moderate medium prismatic structure parting to moderate very fine subangular blocky; very hard, friable, sticky, and plastic; shiny surfaces on most peds; about 2 percent pebbles; neutral; gradual wavy boundary.

B22—22 to 38 inches; dark grayish brown (2.5Y 4/2) clay loam, grayish brown (2.5Y 5/2) dry; moderate coarse and medium prismatic structure parting to moderate very fine subangular blocky; very hard, friable, sticky, and plastic; about 2 percent pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.

C1ca—38 to 50 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; weak fine and medium subangular blocky structure; hard, friable, sticky, and plastic; many medium soft masses of segregated lime; about 5 percent pebbles; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—50 to 60 inches; light olive brown (2.5Y 5/4) loam, pale yellow (2.5Y 7/4) dry; few fine distinct dark yellowish brown (10YR 4/4) and common fine faint dark gray (5Y 4/1) mottles; massive; hard, friable, sticky, and plastic; about 5 percent pebbles and cobbles; some of which are shale; slight effervescence; mildly alkaline.

The thickness of the solum and depth to carbonates is 18 to 40 inches. Thickness of the mollic epipedon is 16 to 24 inches.

An O1 horizon is present in some profiles. The A horizon has hue of 10YR, value of 2 in the upper part and 2 or 3 in the lower part (3 or 4 dry), and chroma of 1.

The B2 horizon has hue of 2.5Y and 10YR in the upper part of some pedons, value of 3 or 4 (4 or 5 dry), and chroma of 2 through 4.

The C horizon has hue of 2.5Y, value of 5 or 6 (6 or 7 dry), and chroma of 2 or 4. Texture is loam or clay loam. Reaction is mildly alkaline or moderately alkaline. Mottles are common.

Aberdeen series

The Aberdeen series consists of deep, moderately well drained, slowly permeable, sodic soils on glacial lake plains. These soils formed in silty, calcareous lacustrine deposits. Slope is 0 to 1 percent.

Aberdeen soils are similar to the Cathay and Cresbard soils, and are near the LaDelle, Colvin, and Overly soils. Cathay and Cresbard soils formed in material weathered from glacial till sediment. LaDelle, Colvin, and Overly soils have no natric horizon.

Typical pedon from an area of Aberdeen silty clay loam, 1,680 feet north and 1,365 feet west of the southeast corner of sec. 25, T. 156 N., R. 67 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky, and slightly plastic; neutral; abrupt smooth boundary.

A2—7 to 9 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1 and 10YR 6/1) dry; moderate medium platy structure parting to moderate thin platy; slightly hard, friable, slightly sticky, and slightly plastic; neutral; clear wavy boundary.

B&A—9 to 12 inches; black (10YR 2/1) silty clay (B), dark gray (10YR 4/1) dry; weak medium columnar structure parting to strong medium angular blocky; hard, firm, very sticky, and very plastic; with very dark gray (10YR 3/1) silt loam (A), gray (10YR 5/1 and 10YR 6/1) dry coatings on faces of peds; slightly hard, friable, slightly sticky, and slightly plastic; neutral; clear wavy boundary.

B21t—12 to 22 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to strong medium angular blocky; very hard, very firm, very sticky, and very plastic; neutral; clear smooth boundary.

B22t—22 to 26 inches; very dark grayish brown (2.5Y 3/2) silty clay, grayish brown (2.5Y 5/2) dry; moderate medium prismatic structure parting to strong medium angular blocky; very hard, very firm, very sticky, and very plastic; mildly alkaline; clear smooth boundary.

C1cs—26 to 36 inches; grayish brown (2.5Y 5/2) silty clay loam, light gray (2.5Y 7/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky, massive in the lower part; hard, firm, sticky, and plastic; violent effervescence; very few fine nests of gypsum; moderately alkaline; diffuse wavy boundary.

C2cs—36 to 43 inches; light brownish gray (2.5Y 6/2) silty clay loam, white (2.5Y 8/2) dry; few fine distinct light yellowish brown (2.5Y 6/4) mottles; massive and laminated; hard, firm, sticky, and plastic; violent effervescence; very few fine nests of gypsum; moderately alkaline; diffuse wavy boundary.

C3—43 to 60 inches; olive (5Y 5/3) silty clay loam, pale yellow (5Y 7/3) dry; common fine prominent gray (N 5/0) mottles; massive and laminated; hard, firm, sticky and plastic; strong effervescence; very few fine nests of gypsum; moderately alkaline.

The thickness of the solum is 19 to 36 inches. Typically, the Ap horizon is silty clay loam, but silt loam is in the range. It is 6 to 10 inches thick. There are no A2 and B&A horizons where the upper part of the B horizon is mixed by deep tillage with the A1 and A2 horizons.

The B2t horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 through 5 dry), and chroma of 1 through 3. Texture is silty clay, silty clay loam, or clay. Some pedons have a B3 horizon. In some profiles, there is no calcium sulfate, soluble salts, or both, in the lower part of the B horizon or upper part of the C horizon.

The C horizon has hue of 2.5Y or 5Y, value of 4 through 6 (6 through 8 dry), and chroma of 2 through 4. Texture ranges from silt loam to clay.

In some profiles the A horizon is buried. Some profiles contain loam, clay loam till, or thin sand lenses below a depth of 40 inches.

Arvilla series

The Arvilla series consists of deep, somewhat excessively drained, rapidly permeable soils on stream terraces and outwash plains. These soils are shallow or moderately deep over sand and gravel. They formed in a thin mantle of moderately coarse textured material overlying sand and gravel. Slope is 1 to 6 percent.

Arvilla soils are similar to the Binford soils, and are near the Renshaw and Sioux soils. Binford soils contain a high amount of shale particles. Renshaw soils have more clay and less sand in the upper parts of the pedon. Sioux soils do not have a cambic horizon and have sand and gravel within a depth of 14 inches.

Typical pedon from an area of Arvilla sandy loam, 1 to 6 percent slopes, 2,190 feet north and 120 feet west of the southeast corner of sec. 31, T. 153 N., R. 71 W.

Ap—0 to 8 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, very friable, nonsticky, and slightly plastic; about 5 percent gravel; neutral; abrupt smooth boundary.

B2—8 to 15 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 5/3) dry; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky, and slightly plastic; about 2 to 5 percent gravel; neutral; clear wavy boundary.

C1ca—15 to 22 inches; grayish brown (2.5Y 5/2) sandy loam, light brownish gray (2.5Y 6/2) dry; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky, and slightly plastic; many medium segregations of lime; about 5 to 10 percent gravel; violent effervescence; mildly alkaline; clear wavy boundary.

IIC2—22 to 60 inches; yellowish brown (10YR 5/4) coarse sand and gravel, light yellowish brown (10YR 6/4) dry; single grain; loose, nonsticky, and nonplastic; lime coats on bottom of pebbles; about 10 to 20 percent gravel; strong effervescence; mildly alkaline.

The thickness of the solum and depth to sand and gravel is 14 to 25 inches. Thickness of the mollic epipedon is 7 to 20 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. It is 6 to 12 inches thick.

The B2 horizon has hue of 10YR, value of 3 or 4 (4 or 5 dry), and chroma of 2 or 3. It is mainly sandy loam, but the range includes light loam and coarse sandy loam. It is 6 to 12 inches thick.

The C1ca horizon has hue of 2.5Y or 10YR, value of 4 or 5 (5 or 6 dry), and chroma of 2 through 4. It is sandy loam or coarse sandy loam and is mildly alkaline or moderately alkaline. Some pedons do not have a C1ca horizon. The IIC horizon has hue of 2.5Y or 10YR, value of 4 or 5 (5 or 6 dry), and chroma of 2 through 4. Typically, it is coarse sand and gravel or sand and gravel. In the upper part of the horizon, lime coats the underside of the pebbles, but in some pedons the lime is in segregated masses. Reaction is mildly alkaline or moderately alkaline.

Barnes series

The Barnes series consists of deep, well drained soils on glacial till plains. Permeability on these soils is moderately slow. These soils formed in loamy, calcareous glacial till (fig. 12). Slope is 1 to 25 percent.

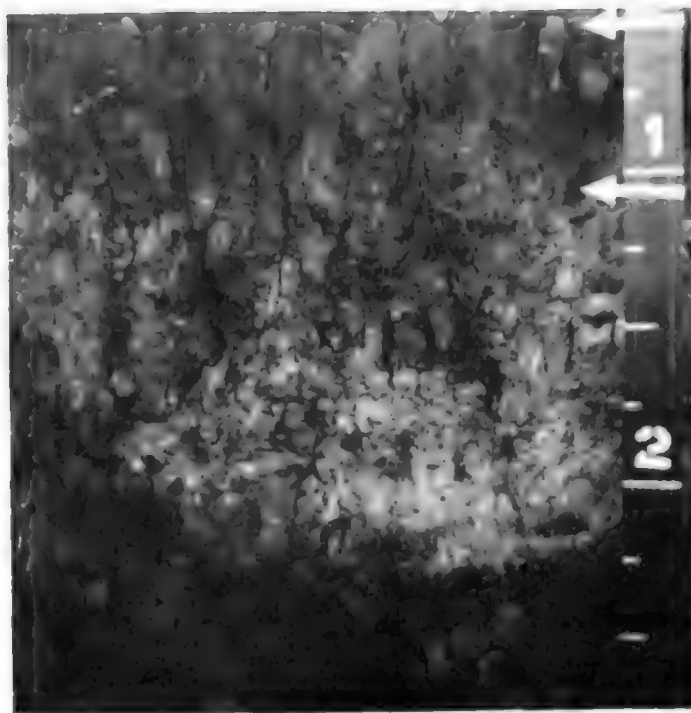


Figure 12.—Profile of Barnes loam showing dark surface layer and calcium accumulation at about 18 inches.

Barnes soils are similar to the Buse, Heimdal, and Svea soils, and are near the Buse, Hamerly, and Svea soils. Buse soils do not have a cambic horizon and have a thinner mollic epipedon. Heimdal soils have less than 18 percent clay. Svea soils have a mollic epipedon more than 16 inches thick, and are below the Barnes soils on concave and nearly level positions. The somewhat poorly drained Hamerly soils are on the edges of shallow depressions and have a horizon of lime accumulation.

Typical pedon of Barnes loam, from an area of Barnes-Svea loams, 3 to 6 percent slopes, 550 feet south and 1,420 feet west of the northeast corner of sec. 32, T. 152 N., R. 66 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure parting to weak very fine granular; hard, friable, slightly sticky, and slightly plastic; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

B2—8 to 14 inches; dark brown (10YR 4/3) loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky, and plastic; few thin clay films on vertical faces of peds; very dark brown (10YR 2/2) coatings on peds; about 2 percent coarse fragments; neutral; clear smooth boundary.

B3—14 to 18 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky, and plastic; about 2 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C1ca—18 to 34 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable, sticky, and plastic; many fine and medium soft masses of segregated lime; about 5 percent coarse fragments; violent effervescence; mildly alkaline; gradual wavy boundary.

C2—34 to 60 inches; light olive brown (2.5Y 5/4) loam, light gray (2.5Y 7/2) dry; few fine prominent strong brown (7.5YR 5/6) mottles; weak medium platy structure and weak very fine subangular blocky; hard, friable, sticky, and plastic; about 2 to 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum is 10 to 22 inches. The 10- to 40-inch control section averages from 18 to 30 percent clay.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. It is 6 to 9 inches thick.

The B2 horizon has hue of 10YR, value of 3 or 4 (5 or 6 dry), and chroma of 2 or 3. It is typically loam, but the range includes light clay loam. The B2 horizon is 5 to 12 inches thick. There is no B3 horizon in some pedons.

The C horizon has hue of 2.5Y, value of 4 or 5 (5 through 7 dry), and chroma of 2 through 4. The lower part of the C horizon has few to many mottles.

Bearden series

The Bearden series consists of deep, somewhat poorly drained soils on glacial lake plains. Permeability on these soils is moderately slow. These soils formed in calcareous lacustrine sediment. Slope is 0 to 1 percent.

Bearden soils are similar to the Colvin and Glyndon soils and are near the Colvin, Great Bend, and Overly soils. Colvin soils are poorly drained and are in swales and lower lying flats. Glyndon soils contain more silt, very fine sand, and less clay. Great Bend and Overly soils are better drained, have a B2 horizon, and are at higher elevations on the lake plain.

Typical pedon from an area of Bearden silt loam, 648 feet west and 70 feet north of the southeast corner of sec. 24, T. 156 N., R. 67 W.

Ap—0 to 10 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate very fine granular structure; hard, friable, slightly sticky, and plastic; slight effervescence; mildly alkaline; abrupt smooth boundary.

ACca—10 to 14 inches; very dark gray (10YR 3/1) light silty clay loam, dark gray (10YR 4/1) dry; weak medium and coarse subangular blocky structure parting to moderate very fine granular; hard, friable, sticky, and plastic; strong effervescence; mildly alkaline; clear wavy boundary.

C1ca—14 to 23 inches; dark grayish brown (2.5Y 4/2) light silty clay loam, grayish brown (10YR 5/2) dry; few fine prominent pale yellow (2.5Y 7/4) mottles; weak medium and coarse subangular blocky structure parting to weak very fine granular; hard, friable, sticky, and plastic; few gypsum crystals in the lower part; violent effervescence; mildly alkaline; clear wavy boundary.

C2—23 to 38 inches; light olive brown (2.5Y 5/4) light silty clay loam, light yellowish brown (2.5Y 6/4) dry; common fine prominent gray (5Y 5/1) mottles; weak coarse subangular blocky structure parting to weak thin platy; hard, friable, sticky, and plastic; few nests and crystals of gypsum; strong effervescence; moderately alkaline; gradual wavy boundary.

C3—38 to 48 inches; light olive brown (2.5Y 5/4) silt loam, light yellowish brown (2.5Y 6/4) dry; many medium prominent gray (5Y 5/1) and many fine faint yellowish brown (10YR 5/4) mottles; weak medium and thin platy structure; hard, friable, sticky, and plastic; strong effervescence; moderately alkaline; clear wavy boundary.

IIC4—48 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; many medium prominent gray (5Y 5/1) and many fine faint yellow-

ish brown (10YR 5/4) mottles; massive; hard, friable, slightly sticky, and slightly plastic; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon is 7 to 16 inches. Carbonates are present throughout the profile.

The A horizon has hue of 10YR or 2.5Y, value of 2 (3 or 4 dry), and chroma of 1 or 2. The ACca horizon has hue of 10YR or 2.5Y, value of 3 or 4 (4 through 6 dry), and chroma of 1 or 2. It is light silty clay loam or silt loam. There is no ACca horizon in some pedons.

The C1ca horizon has hue of 10YR or 2.5Y, value of 4 or 5 (5 through 7 dry), and chroma of 2 through 4. It is silty clay loam or silt loam. The C horizon has hue of 2.5Y, value of 4 through 6 (5 through 7 dry), and chroma of 4. In some pedons, there is no IIC horizon between depths of 40 and 60 inches. The C horizon has hue of 2.5Y, value of 4 through 6 (5 through 7 dry), and chroma of 4. In some pedons there is no IIC horizon between depths of 40 and 60 inches.

Binford series

The Binford series consists of deep, well drained and somewhat excessively drained, rapidly permeable soils on glacial outwash plains and stream terraces. These soils are shallow or moderately deep over sand and gravel that is mainly shale in origin. They formed in outwash containing a large amount of shale. Slope is 1 to 6 percent.

Binford soils are similar to the Arvilla soils and are near the Brantford, Coe, and Vang soils. Arvilla soils do not contain a high amount of shale particles in the C horizon. Brantford and Vang soils have more clay and less sand in the upper part of the pedon, and are deeper to shaly sand and gravel. Coe soils are more shallow to shaly sand and gravel and have no cambic horizon.

Typical pedon from an area of Binford sandy loam, 1 to 6 percent slopes, 2,120 feet north and 75 feet west of southeast corner of sec. 35, T. 151 N., R. 65 W.

Ap—0 to 6 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak, fine and medium subangular blocky structure; soft, very friable, nonsticky, and slightly plastic; neutral; abrupt smooth boundary.

A12—6 to 9 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure; slightly hard, very friable, nonsticky, and slightly plastic; mildly alkaline; clear wavy boundary.

B21—9 to 15 inches; dark brown (10YR 3/3) sandy loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable, nonsticky, and slightly plastic; mildly alkaline; clear wavy boundary.

B22—15 to 20 inches; dark grayish brown (2.5Y 4/2) sandy loam, light brownish gray (2.5Y 6/2) dry; weak fine and medium subangular blocky structure; soft, very friable, nonsticky, and slightly plastic; mildly alkaline; clear wavy boundary.

IIC1ca—20 to 24 inches; grayish brown (2.5Y 5/2) shaly sandy loam, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky, and nonplastic; about 20 percent shale fragments; strong effervescence; mildly alkaline; clear wavy boundary.

IIC2—24 to 37 inches; dark grayish brown (2.5Y 4/2) shaly coarse loamy sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky, and nonplastic; about 15 percent shale fragments; strong effervescence; mildly alkaline; clear wavy boundary.

IIC3—37 to 60 inches; dark grayish brown (2.5Y 4/2) shaly coarse loamy sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky, and nonplastic; about 10 percent shale fragments; strong effervescence; mildly alkaline.

The thickness of the solum and depth to underlying sand and gravel is 14 to 25 inches. The Ap horizon is 5 to 9 inches thick.

The B2 horizon has hue of 10YR or 2.5Y, value of 2 through 4 (4 through 6 dry), and chroma of 1 through 3. In some profiles it has organic coatings on faces of peds.

The IIC horizon is shaly sand, shaly sandy loam or gravel or shaly loamy coarse sand. Some profiles contain thin lenses of granitic sand and gravel in the IIC horizon. In the upper part of the horizon, lime coats the undersides of pebbles, but in some pedons lime is in soft, segregated masses.

Borup series

The Borup series consists of deep, poorly drained soils on glacial lake plains. Permeability on these soils is moderately rapid. These soils formed in medium textured, calcareous lacustrine sediment. Slope is 0 to 3 percent.

Borup soils are similar to the Colvin and Glyndon soils, and are near the Glyndon soils. Colvin soils contain more clay. Glyndon soils are somewhat poorly drained and are on slightly higher positions.

Typical pedon from an area of Borup silt loam, 560 feet west and 2,225 feet south of the northeast corner of sec. 31, T. 155 N., R. 69 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; hard, very friable, slightly sticky, and slightly plastic; strong effervescence; mildly alkaline; abrupt smooth boundary.

A12ca—7 to 12 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak coarse subangular

blocky structure parting to moderate very fine granular; hard, friable, slightly sticky, and slightly plastic; strong effervescence; disseminated lime throughout; mildly alkaline; gradual broken boundary.

C1ca—12 to 18 inches; dark gray (5Y 4/1) silt loam, light gray and gray (5Y 6/1) and 5/1 dry; weak coarse subangular blocky structure parting to moderate very fine subangular blocky and granular; hard, friable, slightly sticky, and plastic; very dark gray (10YR 3/1) streaks and tongues; violent effervescence; disseminated lime throughout; mildly alkaline; gradual broken boundary.

C2ca—18 to 30 inches; gray (5Y 5/1) silt loam, light gray (5Y 7/1) dry; many fine faint olive gray (5Y 5/2) mottles; weak coarse subangular blocky structure parting to moderate very fine granular and subangular blocky; hard, friable, slightly sticky, and plastic; few very dark gray (10YR 3/1) streaks; violent effervescence; disseminated lime throughout; mildly alkaline; gradual wavy boundary.

C3g—30 to 34 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; many large faint gray (5Y 5/1) and many large distinct light yellowish brown (10YR 6/4) mottles; weak coarse subangular blocky structure parting to moderate very fine granular and subangular blocky; hard, friable, slightly sticky, and plastic; strong effervescence; mildly alkaline; gradual wavy boundary.

C4g—34 to 60 inches; olive brown (2.5Y 4/4) and gray (5Y 5/1) very fine sandy loam, yellowish brown (10YR 5/4) and light gray (5Y 6/1) dry; few fine prominent dark reddish brown (5Y 2/2) mottles; single grain; hard, very friable, nonsticky, and slightly plastic; slight effervescence; mildly alkaline.

The thickness of the solum and the mollic epipedon is 7 to 18 inches. Depth to the calcic horizon is less than 16 inches. Some pedons are saline.

The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1; or it is N 2/0 or N 3/0 (N 4/0 or N 5/0 dry).

The Cca horizon has hue of 2.5Y or 5Y, value of 4 or 5 (5 through 7 dry), and chroma of 1 or 2. It is silt loam or very fine sandy loam. Typically, the C horizon is silty loam or very fine sandy loam but ranges to very fine sand. Some pedons have stratified sand, fine gravel, or loam below a depth of 40 inches.

Bottineau series

The Bottineau series consists of deep, well drained soils on glacial till plains and moraines. Permeability on these soils is moderately slow. These soils formed in loamy glacial till. Slope is 3 to 15 percent.

Bottineau soils are similar to the Barnes soils and are near the Edgeley variant, Parnell, and Tonka soils. Barnes and Edgeley variant soils have no argillic horizon.

In addition, Edgeley variant soils contain large amounts of shale fragments and are steeper. Parnell and Tonka soils are in potholes and are more poorly drained.

Typical pedon from an area of Bottineau loam, 9 to 15 percent slopes, 2,040 feet west and 150 feet north of the southeast corner of sec. 34, T. 153 N., R. 64 W.

A11—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; slightly hard, very friable, slightly sticky, and slightly plastic; 2 to 5 percent pebbles; slightly acid; clear smooth boundary.

A12—6 to 9 inches; black (10YR 2/1) light clay loam, dark gray (10YR 4/1) dry; moderate medium and fine subangular blocky structure; very hard, friable, slightly sticky, and plastic; common uncoated sand grains on faces of peds; 2 to 5 percent pebbles; slightly acid; clear wavy boundary.

B2t—9 to 16 inches; very dark grayish brown (2.5Y 3/2) clay loam, grayish brown (2.5Y 5/2) dry; weak coarse prismatic structure parting to moderate medium subangular blocky and strong fine angular blocky; very hard, firm, sticky, and plastic; common moderately thick very dark grayish brown (10YR 3/2) clay films on faces of peds; common uncoated sand grains on faces of peds; 2 to 5 percent pebbles; neutral; clear wavy boundary.

B3—16 to 19 inches; dark grayish brown (2.5Y 4/2) clay loam, light brownish gray (2.5Y 6/2) dry; weak coarse prismatic structure parting to moderate medium angular blocky; hard, friable, sticky, and plastic; 2 to 5 percent pebbles; slight effervescence; mildly alkaline; gradual wavy boundary.

C1ca—19 to 33 inches; light olive brown (2.5Y 5/4) loam, light gray (2.5Y 7/2) dry; weak coarse and medium subangular blocky structure; hard, friable, sticky, and plastic; common fine masses of lime; 2 to 5 percent pebbles; strong effervescence; mildly alkaline; gradual wavy boundary.

C2ca—33 to 54 inches; light olive brown (2.5Y 5/4) loam, pale yellow (2.5Y 7/4) dry; massive; hard, friable, sticky, and plastic; 2 to 5 percent pebbles; strong effervescence; mildly alkaline; gradual wavy boundary.

C3—54 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine distinct brown (7.5YR 4/4) mottles; massive; hard, friable, sticky, and plastic; 2 to 5 percent pebbles and shale fragments; strong effervescence; moderately alkaline.

The thickness of the solum is 16 to 30 inches. The mollic epipedon is 7 to 16 inches thick. The pedon contains 2 to 10 percent pebbles by volume.

The A horizon has hue of 10YR value of 2 or 3 (3 or 4 dry), and chroma of 1.

The B2t horizon has hue of 10YR or 2.5Y, value of 3 or 4 (5 or 6 dry), and chroma of 2 or 3. It is loam or clay loam. There is no B3 horizon in some pedons.

The C horizon has hue of 2.5Y, value of 4 or 5 (6 or 7 dry), and chroma of 2 or 4. It is loam or clay loam.

Brantford series

The Brantford series consists of deep, well drained soils on glacial outwash plains and stream terraces. These soils are moderately permeable in the upper part and very rapidly permeable in the underlying material. They are shallow over sand and gravel that is mainly shale in origin. These soils formed in outwash containing a large amount of shale. Slope is 1 to 9 percent.

Brantford soils are similar to the Renshaw soils and are near the Binford, Coe, and Vang soils. Renshaw soils do not contain a high amount of shale particles in the IIC horizon. Binford soils have less clay and more sand in the upper part of the pedon and are more shallow to shaly sand and gravel. Coe soils have no cambic horizon and are more shallow to shaly sand and gravel. Vang soils are deeper to shaly sand and gravel.

Typical pedon from an area of Brantford loam, 1 to 3 percent slopes, 1,030 feet east and 75 feet north of the southwest corner of sec. 7, T. 151 N., R. 65 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure parting to moderate medium and fine granular; slightly hard, friable, slightly sticky, and slightly plastic; slightly acid, abrupt smooth boundary.

A12—6 to 8 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky, and slightly plastic; slightly acid; abrupt smooth boundary.

B2—8 to 13 inches; dark brown (2.5Y 4/2) loam, brown (2.5Y 5/4) dry; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky, and slightly plastic; neutral; abrupt smooth boundary.

C1—13 to 16 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; weak medium and fine subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky, and slightly plastic; lime crusts on gravel; about 10 percent gravel; mildly alkaline, clear wavy boundary.

IIC2—16 to 19 inches; dark grayish brown (2.5Y 4/2) shaly loamy coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky, and nonplastic; about 40 percent gravel; slight effervescence, moderately alkaline; clear wavy boundary.

IIC3—19 to 34 inches; dark grayish brown (2.5Y 4/2) very shaly coarse sand, light brownish gray (2.5Y

6/2) dry; single grain; loose, nonsticky, and nonplastic; about 40 percent gravel; strong effervescence, moderately alkaline; clear wavy boundary.

IIC4—34 to 60 inches; dark grayish brown (2.5Y 4/2) very gravelly coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky, and nonplastic; about 35 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum and depth to underlying sand and gravel is 10 to 20 inches but is typically 15 to 20 inches. The A horizon is 4 to 12 inches thick.

The B2 horizon has hue of 2.5Y, value of 3 or 4 (4 or 5 dry), and chroma of 1 through 4. It is 4 to 12 inches thick.

The IIC horizon contains at least 35 percent shale fragments by volume. In the upper part of the horizon, lime coats the undersides of pebbles.

Buse series

The Buse series consists of deep, well drained soils on convex slopes of glacial moraines and till plains. Permeability is moderately slow. These soils formed in loamy, calcareous glacial till. Slope is 3 to 25 percent.

Buse soils are similar to the Esmond and Hamerly soils and are near the Barnes and Svea soils. Esmond soils have less clay in the control section. Hamerly soils are somewhat poorly drained. Barnes soils have a B2 horizon. Svea soils have a mollic epipedon more than 16 inches thick.

Typical pedon of Buse loam from an area of Barnes-Buse loams, 6 to 9 percent slopes, 950 feet south and 2,540 feet west of the northeast corner of sec. 12, T. 151 N., R. 67 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak very fine and fine granular structure; slightly hard, friable, slightly sticky, and slightly plastic; about 5 percent pebbles and coarse fragments; strong effervescence; mildly alkaline; abrupt smooth boundary.

C1ca—8 to 15 inches; grayish brown (2.5Y 5/2) heavy loam, light gray (2.5Y 7/2) dry; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable, sticky, and plastic; few fine segregations of lime; about 5 percent pebbles and coarse fragments; violent effervescence; mildly alkaline; gradual wavy boundary.

C2—15 to 34 inches; light olive brown (2.5Y 5/4) heavy loam, light brownish gray (2.5Y 6/2) dry; weak coarse prismatic structure parting to weak fine subangular blocky; hard, friable, slightly sticky, and plastic; about 5 percent pebbles and coarse fragments; strong effervescence; mildly alkaline; gradual wavy boundary.

C3—34 to 60 inches; light olive brown (2.5Y 5/4) heavy loam, light yellowish brown (2.5Y 6/4) dry; few fine distinct strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; hard, friable, slightly sticky, and plastic; about 5 percent pebbles and coarse fragments; strong effervescence; mildly alkaline.

The mollic epipedon is 7 to 10 inches. The depth to carbonates is 0 to 10 inches. The profile contains 2 to 10 percent coarse fragments by volume. The 10 - to 40-inch control section averages from 20 to 25 percent clay.

The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1. Reaction is neutral or mildly alkaline.

The C1ca horizon has hue of 10YR or 2.5Y, value of 4 or 5 (5 through 7 dry), and chroma of 2 through 4. Lime segregations are few or common.

The C horizon has hue of 10YR or 2.5Y, value of 5 or 6 (6 or 7 dry), and chroma of 2 through 4. Typically, the C horizon is heavy loam, but the range includes clay loam. It is mildly alkaline to moderately alkaline.

Cathay series

The Cathay series consists of deep, moderately well drained, slowly permeable, sodic soils on glacial till plains, basins, coulees and drainageways. These soils formed in loamy glacial till. Slope is 1 to 6 percent.

These soils do not have the degree of interfingering of the Albic horizon into the natric horizon that is characteristic of the Glossic Udic Natriborolls. This difference does not alter the usefulness and behavior of the soils.

Cathay soils are similar to the Cresbard and Larson soils and are near the Emrick, Fram, and Larson soils. Cresbard soils have more clay in the B2t horizon. Larson soils have a thinner A horizon and do not have interfingering of A2 horizon material into the B2t horizon. Emrick and Fram soils have no natric B2t horizon. Fram soils contain a calcic horizon.

Typical pedon of Cathay loam from an area of Fram-Cathay loams, 1 to 3 percent slopes, 1,380 feet north and 1,340 feet east of the southwest corner of sec. 5, T. 152 N., R. 70 W.

A1—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure parting to weak fine subangular blocky; soft, friable, slightly sticky, and slightly plastic; mildly alkaline; abrupt smooth boundary.

A2—8 to 9 inches; dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; moderate coarse and medium platy structure; slightly hard, friable, slightly sticky, and slightly plastic; moderately alkaline; clear wavy boundary.

B21t—9 to 13 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry;

weak coarse columnar structure parting to moderate medium prismatic and strong fine angular blocky; hard, firm, sticky, and plastic; many thin organic stains and clay films on faces of peds; moderately alkaline; clear wavy boundary.

B22t—13 to 17 inches; olive brown (2.5Y 4/4) clay loam, light olive brown (2.5Y 5/4) dry; strong medium angular blocky structure; hard, firm, sticky, and plastic; few thin clay films on faces of peds and lime pores; strongly alkaline; clear wavy boundary.

C1ca—17 to 25 inches; light olive brown (2.5Y 5/4) clay loam, pale yellow (2.5Y 7/4) dry; massive; hard, firm, sticky, and plastic; violent effervescence; strongly alkaline; diffuse wavy boundary.

C2cacs—25 to 48 inches; olive brown and grayish brown (2.5Y 4/4 and 5/2) clay loam, light yellowish brown and light gray (2.5Y 6/4 and 7/2) dry; massive; hard, firm, sticky, and plastic; violent effervescence; common fine nests of gypsum crystals; strongly alkaline; diffuse wavy boundary.

C3cacs—48 to 60 inches; olive brown (2.5Y 4/4) clay loam, light yellowish brown (2.5Y 6/4) dry; massive; hard, firm, sticky, and plastic; strong effervescence; common fine nests of gypsum crystals; strongly alkaline.

The thickness of the solum is 16 to 36 inches. Some pedons have no A2 horizon but have an A & B horizon. The A & B horizon is 1/2 inch to 4 inches thick and typically loam or silt loam.

The B2t horizon has hue of 10YR or 2.5Y, value of 3 or 4 (3 through 5) dry, and chroma of 1 through 4. It is 8 to 20 inches in thickness and is typically clay loam, but ranges to loam.

The C horizon has hue of 2.5Y, value of 3 through 6 (5 through 7 dry), and chroma of 2 through 4. It is loam or clay loam. Some pedons have stratified sand in the C horizon.

Cavour series

The Cavour series consists of deep, moderately well drained, very slowly permeable sodic soils on till plains and foot slopes. These soils formed in loamy glacial till. Slope is 1 to 6 percent.

Cavour soils are similar to the Cresbard, Larson, and Miranda soils and are near the Barnes, Hamerly, and Svea soils. Cresbard soils have interfingering of A2 horizon material into the B2t horizon. Larson soils have less clay in the B2t horizon. Miranda soils have a thinner solum and accumulations of salts nearer the surface. Barnes, Hamerly, and Svea soils do not have a natric horizon.

Typical pedon of Cavour silt loam, from an area of Cavour-Miranda complex, 1 to 6 percent slopes, 72 feet west and 2,370 feet north of the southeast corner of sec. 30, T. 151 N., R. 67 W.

- A1—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky, and slightly plastic; neutral; gradual smooth boundary.
- A2—7 to 10 inches; very dark gray (10YR 3/1) silt loam, light gray and gray (10YR 6/1) dry; weak thin platy structure parting to weak fine granular; soft, very friable, slightly sticky, and slightly plastic; mildly alkaline; abrupt wavy boundary.
- B21t—10 to 14 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate medium columnar structure parting to moderate medium angular blocky; very hard, very firm, very sticky, and very plastic; many moderately thick clay films on faces of peds and in pores; dark gray (10YR 4/1) column tops, light gray (10YR 7/1) dry; moderately alkaline; gradual wavy boundary.
- B22t—14 to 23 inches; black (10YR 2/1) clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, very firm, very sticky, and very plastic; continuous moderately thick clay films on faces of peds and in pores; moderately alkaline; gradual wavy boundary.
- C1sa—23 to 34 inches; dark grayish brown (2.5Y 4/2) clay loam, light brownish gray (2.5Y 6/2) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, friable, sticky, and plastic; violent effervescence; strongly alkaline; gradual wavy boundary.
- C2—34 to 45 inches; olive brown (2.5Y 4/4) clay loam, light brownish gray (2.5Y 6/2) dry; many fine distinct pale olive (5Y 6/3), few medium distinct dark brown (7.5YR 4/4), and few fine distinct yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; slightly hard, friable, sticky, and plastic; strong effervescence; strongly alkaline; abrupt wavy boundary.
- C3—45 to 60 inches; light olive brown (2.5Y 5/4) clay loam, light gray (2.5Y 7/2) dry; common fine faint light yellowish brown (2.5Y 6/4) mottles; moderate medium subangular blocky structure; hard, firm, very sticky, and very plastic; strong effervescence; strongly alkaline.

The thickness of the solum and the depth to carbonates is 18 to 24 inches.

The A1 horizon has hue of 10YR, value of 2 (3 or 4 dry), and chroma of 1. It is silt loam, loam, or clay loam and is 4 to 8 inches thick. The A2 horizon has hue of 10YR, value of 3 or 4 (5 or 6 dry), and chroma of 1. It is silt loam or loam and is 1 to 3 inches thick. In cultivated fields, the A1 horizon, the A2 horizon, and the upper part of the B2t horizon are mixed.

The B2t horizon has hue of 10YR, value of 2 through 4 (3 through 5 dry), and chroma of 1. It is silty clay, clay,

or clay loam and is from 35 to 45 percent clay. The horizon is 9 to 24 inches thick. Reaction is mildly alkaline or moderately alkaline. A B3 horizon containing salts is in some pedons.

The C horizon has hue of 2.5Y, value of 4 or 5 (6 or 7 dry), and chroma of 2 or 4. It is clay loam or silty clay loam and is moderately alkaline or strongly alkaline.

Claire series

The Claire series consists of deep, excessively drained, soils on old lake beaches and sand bars. They are rapidly permeable in the upper part of the profile. Permeability in the lower part is moderately slow. These soils formed in water-sorted material. Slope is 1 to 9 percent.

These soils have an irregular distribution of organic matter and are located on lake beaches. In these respects they differ from the defined Claire series. These differences do not alter the usefulness and behavior of the soils.

Claire soils are near the Sioux soils. Sioux soils have a thicker A horizon and contain more gravel throughout the profile.

Typical pedon from an area of Claire loamy coarse sand, loamy substratum, 1 to 9 percent slopes, 155 feet west and 95 feet north of the southeast corner of sec. 1, T. 153 N., R. 66 W.

- A1—0 to 5 inches; very dark grayish brown (10YR 3/2) loamy coarse sand, dark grayish brown (10YR 4/2) dry; single grain, loose, nonsticky, and nonplastic; mildly alkaline; abrupt smooth boundary.
- C1—5 to 8 inches; dark grayish brown (2.5Y 4/2) coarse sand, light brownish gray (2.5Y 6/2) dry; single grain, loose, nonsticky, and nonplastic; about 6 percent gravel; mildly alkaline; clear wavy boundary.
- C2—8 to 25 inches; grayish brown (2.5Y 5/2) coarse sand, light gray (2.5Y 7/2) dry; single grain; loose, nonsticky, and nonplastic; about 6 percent gravel; mildly alkaline; clear wavy boundary.
- A1b1—25 to 28 inches; very dark grayish brown (2.5Y 3/2) loamy coarse sand, dark grayish brown (2.5Y 4/2) dry; single grain; loose, nonsticky, and nonplastic; about 14 percent gravel; mildly alkaline; abrupt smooth boundary.
- C3—28 to 39 inches; dark grayish brown (2.5Y 4/2) and very dark grayish brown (2.5Y 3/2) coarse sand, grayish brown (2.5Y 5/2) and dark grayish brown (2.5Y 4/2) dry; single grain; loose, nonsticky, and nonplastic; about 14 percent gravel; mildly alkaline; clear wavy boundary.
- A1b2—39 to 42 inches; black (10YR 2/1) loamy coarse sand; dark gray (10YR 4/1) dry; single grain; loose, nonsticky, and nonplastic; about 5 percent gravel; mildly alkaline; clear wavy boundary.

IIA1b3—42 to 47 inches; black (10YR 2/1) sandy clay loam, dark gray (10YR 4/1) dry; massive; slightly hard, firm, sticky, and plastic; mildly alkaline, clear wavy boundary.

IIC4—47 to 60 inches; very dark grayish brown (2.5Y 3/2) sandy clay loam, grayish brown (2.5Y 5/2) dry; massive; slightly hard, firm, sticky, and plastic; slight effervescence; mildly alkaline.

Depth to sandy clay loam, clay loam, or loam is 40 to 60 inches. The 10- to 40-inch control section is typically coarse sand having less than 50 percent medium and fine sand.

The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2.

The C horizon has hue of 2.5Y or 5Y, value of 3 through 5 (4 through 7 dry), and chroma of 2 or 3. Some pedons have no buried A horizon within a depth of 40 inches.

Coe series

The Coe series consists of deep, excessively drained soils on outwash plains and stream valleys or coulee side slopes. Permeability in the upper part of these soils is moderate or moderately rapid and is very rapid in the underlying material. These soils are shallow over sand and gravel. They formed in outwash containing a large amount of shale. Slope is 1 to 25 percent.

Coe soils are similar to the Binford, Brantford, and Sioux soils and are near the Brantford and Vang soils. Binford, Brantford, and Vang soils have a B horizon. Sioux soils have no shaly C horizon.

Typical pedon from an area of Coe shaly loam, 9 to 25 percent slopes, 1,470 feet south and 105 feet east of the northwest corner of sec. 23., T. 152 N., R. 66 W.

Ap—0 to 7 inches; black (10YR 2/1) shaly loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, very friable, slightly sticky, and slightly plastic; slight effervescence; mildly alkaline; clear smooth boundary.

C1—7 to 18 inches; dark gray (5Y 4/1) and dark grayish brown (2.5Y 4/2) shaly coarse sand, gray (5Y 5/1) and light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky, and nonplastic; few segregations of lime and lime coats on bottom of pebbles; slight and strong effervescence; mildly alkaline; gradual smooth boundary.

C2—18 to 60 inches; dark gray (5Y 4/1) and dark grayish brown (2.5Y 4/2) shaly coarse sand and gravel, gray (5Y 5/1) and light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky, and nonplastic; slight effervescence; moderately alkaline.

The thickness of the solum and the depth to sand and gravel is 6 to 10 inches. Carbonates are common throughout the profile.

The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1. Reaction is neutral or mildly alkaline.

The C horizon has hue of 2.5Y and 5Y, value of 4 or 5 (5 through 7 dry), and chroma of 1 through 3.

Colvin series

The Colvin series consists of deep, poorly drained and very poorly drained soils in shallow depressions on glacial lake plains and in old stream channels. Permeability of these soils is moderately slow. These soils formed in silty calcareous alluvium and lacustrine sediment. Slope is 0 to 1 percent.

Colvin soils are similar to the Bearden, Borup, and Vallers soils and are near the Aberdeen and Overly soils. Bearden soils are somewhat poorly drained. Borup soils contain less clay. Vallers soils contain more sand and formed in glacial till. Aberdeen soils are sodic. Overly soils have a B horizon and have no calcic horizon within a depth of 16 inches.

Typical pedon from an area of Colvin silt loam, 700 feet east and 155 feet south of the northwest corner of sec. 31, T. 152 N., R. 71 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; hard, friable, slightly sticky, and slightly plastic; strong effervescence; mildly alkaline; abrupt smooth boundary.

A12—7 to 12 inches; very dark gray (N 3/0) silt loam, dark gray (N 4/0) dry; weak medium and coarse subangular blocky structure parting to moderate very fine granular; hard, friable, slightly sticky, and slightly plastic; violent effervescence; mildly alkaline; clear wavy boundary.

C1ca—12 to 18 inches; dark gray (N 4/0) silty clay loam, gray (N 6/0) dry; weak medium and coarse subangular blocky structure parting to moderate very fine granular; hard, friable, sticky, and plastic; violent effervescence; mildly alkaline; clear wavy boundary.

C2ca—18 to 30 inches; dark gray (5Y 4/1) silty clay loam, gray (5Y 6/1) dry; few fine distinct olive (5Y 5/3) mottles; weak medium and coarse subangular blocky structure parting to moderate very fine granular; hard, friable, sticky, and plastic; violent effervescence; mildly alkaline; clear wavy boundary.

C3g—30 to 44 inches; dark gray (5Y 4/1) silty clay loam, gray (5Y 6/1) dry; few fine distinct olive (5Y 5/3) mottles; weak coarse subangular blocky structure parting to weak very fine granular; hard, friable, sticky, and plastic; strong effervescence; mildly alkaline; clear wavy boundary.

C4g—44 to 60 inches; olive gray and olive (5Y 5/2 and 5/3) loam, light gray and pale yellow (5Y 7/2 and 7/3) dry; many large distinct yellowish brown (10YR 5/4) mottles; massive; hard, friable, slightly sticky, and slightly plastic; strong effervescence; mildly alkaline.

The thickness of the solum and mollic epipedon is 7 to 16 inches. Some pedons are saline. Reaction of the pedon is mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1, or is N 2/0 or N 3/0 (N 3/0 or N 4/0 dry). It is silt loam or silty clay loam.

The Cca horizon has hue of 2.5Y or 5Y, value of 4 through 6 (5 through 8 dry), and chroma of 1 or 2; or it is N 4/0 through N 6/0 (N 5/0 through N 8/0 dry). It is silt loam or silty clay loam. Mottles are at a depth of about 20 inches, range from few to many, and are faint or distinct. The Cg horizon has hue of 5Y, value of 4 through 6 (5 through 7 dry), and chroma of 1 through 3. It is silt loam or silty clay loam, but some pedons, below a depth of 40 inches, have stratified sand, loam, or clay loam.

Cresbard series

The Cresbard series consists of deep, moderately well drained, slowly permeable sodic soils on till plains and foot slopes. These soils formed in loamy, calcareous glacial till or loamy local alluvium over glacial till. Slope is 1 to 6 percent.

These soils do not have the degree of interfingering of the albic horizon into the natric horizon that is characteristic of the Glossic Udic Natriborolls. This difference does not alter the usefulness and behavior of the soils.

Cresbard soils are similar to the Aberdeen, Cathay, and Cavour soils and are near the Cavour, Hamerly, and Svea soils. Aberdeen soils formed in lacustrine sediment. Cathay soils contain less clay in the B2t horizon. Cavour soils do not have interfingering of A2 horizon material into the B2 horizon. Hamerly and Svea soils do not have a natric horizon.

Typical pedon of Cresbard loam, from an area of Svea-Cresbard loams, 3 to 6 percent slopes, 1,330 feet south and 165 feet east of the northwest corner of sec. 5, T. 155 N., R. 70 W.

A1—0 to 6 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky and granular structure; slightly hard, friable, slightly sticky, and slightly plastic; neutral; abrupt smooth boundary.

A2—6 to 8 inches; dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; moderate coarse and medium subangular blocky structure parting to moderate medium platy; slightly hard, friable, nonsticky, and slightly plastic; neutral; abrupt wavy boundary.

B21t—8 to 12 inches; dark grayish brown (10YR 4/2) silty clay, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to strong fine angular blocky; very hard, very firm, very sticky, and very plastic; light brownish gray (10YR 6/2) dry very fine sand grains coating the upper 1-1/2 inches of the prisms; moderately alkaline; gradual smooth boundary.

B22t—12 to 16 inches; very dark grayish brown (2.5Y 3/2) silty clay, grayish brown (2.5Y 5/2) dry; moderate medium prismatic structure parting to strong medium and fine angular blocky; very hard, very firm, very sticky, and very plastic; many moderately thick clay films on faces of peds and in pores; moderately alkaline; gradual wavy boundary.

C1ca—16 to 24 inches; olive brown (2.5Y 4/4) clay loam, light olive brown (2.5Y 5/4) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, sticky, and plastic; common medium and fine soft masses of segregated lime; violent effervescence; strongly alkaline; gradual wavy boundary.

C2—24 to 32 inches; dark grayish brown (2.5Y 4/2) clay loam, light brownish gray (2.5Y 6/2) dry; common fine distinct dark gray (N 4/0) mottles; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, friable, sticky, and plastic; strong effervescence; moderately alkaline; gradual wavy boundary.

C3—32 to 60 inches; dark grayish brown (2.5Y 4/2) clay loam, light brownish gray (2.5Y 6/2) dry; few fine distinct dark gray (N 4/0) mottles; strong medium subangular blocky structure; hard, friable, sticky, and plastic; slight effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates is 16 to 36 inches.

The A1 horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. Typically, it is loam, but clay loam is in the range. The A1 horizon is 5 to 10 inches thick. The A2 horizon has hue of 10YR, value of 3 or 4 (5 or 6 dry), and chroma of 1 or 2. It is loam or silt loam and is 1/2 inch to 3 inches thick. In cultivated areas the A1 and A2 horizons are mixed.

The B2t horizon has hue of 10YR or 2.5Y, value of 3 or 4 (4 or 5 dry), and chroma of 1 or 2. It is silty clay or clay and is 8 to 12 inches thick. Some pedons have a B3 horizon.

The C horizon has hue of 2.5Y, value of 4 or 5 (5 through 7 dry), and chroma of 2 or 4. Typically, it is clay loam, but the range includes loam. In some pedons, crystals of calcium sulfate and other salts are in the upper part of the C horizon.

Darnen series

The Darnen series consists of deep, moderately well drained, moderately permeable soils on colluvial-alluvial sediment in stream valleys. These soils formed in loamy colluvium and alluvium. Slope is 3 to 6 percent.

Darnen soils are similar to the Aastad and Svea soils and are near the Esmond, Heimdal, Lamoure, and Ryan soils. Aastad soils have a higher clay content in the B horizon and a thinner mollic epipedon. Svea soils have a thinner A horizon and a calcic horizon at a depth of about 22 inches. Esmond and Heimdal soils have a lower clay content and formed in glacial till. Ryan soils have a natric horizon and are poorly drained. Lamoure soils contain more silt, are poorly drained, and are calcareous throughout.

Typical pedon from an area of Darnen loam, 3 to 6 percent slopes, 1,480 feet north and 350 feet east of the southwest corner of sec. 28, T. 152 N., R 65 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to moderate fine granular; soft, friable, slightly sticky, and slightly plastic; neutral; abrupt smooth boundary.

A12—7 to 18 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; soft, friable, slightly sticky, and slightly plastic; neutral; abrupt wavy boundary.

A13—18 to 22 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky, and slightly plastic; slightly acid; clear wavy boundary.

B1—22 to 28 inches; very dark grayish brown (2.5Y 3/2) loam, dark grayish brown (2.5Y 4/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky, and slightly plastic; neutral; clear wavy boundary.

B2—28 to 34 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky, and slightly plastic; slightly acid; clear wavy boundary.

C1ca—34 to 45 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; massive; soft, friable, slightly sticky, and slightly plastic; violent effervescence; about 2 percent pebbles; mildly alkaline; gradual wavy boundary.

C2ca—45 to 52 inches; dark grayish brown (2.5Y 4/2) loam, light gray (2.5Y 7/2) dry; massive; soft, friable, slightly sticky, and slightly plastic; violent effervescence; about 2 percent pebbles; mildly alkaline; gradual wavy boundary.

C3—52 to 60 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; massive; soft, friable, slightly sticky, and slightly plastic; strong effervescence with violently effervescent lime in medium irregularly shaped segregated soft masses; about 2 percent pebbles; mildly alkaline.

The thickness of the solum is 30 to 50 inches. The mollic epipedon is 20 to 48 inches thick. Depth to carbonates varies from 20 to 50 inches. The 10- to 40-inch control section averages from 18 to 30 percent clay.

The A horizon has hue of 10YR, value of 2 in the upper part and 2 or 3 in the lower part, and chroma of 1 or 2. It is 18 to 29 inches thick. Some pedons have a thin A3 horizon.

The B horizon has hue of 10YR or 2.5Y, value of 3 through 5, and chroma of 2 through 4. It is typically loam, but light clay loam is in the range. The horizon is 0 to 18 inches thick, but it is usually 8 to 18 inches thick.

The C horizon has hue of 2.5Y, value of 4 through 6, and chroma of 2 through 6. It is typically loam, but light clay loam is in the range. Some pedons are sandy loam, clay loam, or clay below a depth of 40 inches. Some pedons have a buried A horizon below a depth of 40 inches.

Dickey series

The Dickey series consists of deep, well drained soils on sandy mantled glacial plains, moraines, or lake plains. Permeability of these soils is rapid in the upper part and moderately slow in the lower part. These soils formed in aeolian material deposited over loamy glacial till or silty lacustrine sediment. Slope is 6 to 9 percent.

Dickey soils are similar to the Hecla, Maddock, and Towner soils and are near the Egeland, Embden, Hecla, Maddock, and Towner soils. Egeland, Embden, Hecla, and Maddock soils have no loamy IIC horizon. Towner soils have a mollic epipedon more than 16 inches thick.

Typical pedon from an area of Dickey fine sandy loam, 6 to 9 percent slopes, 140 feet south and 95 feet east of the northwest corner of sec. 15, T. 156 N., R. 71 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium and fine subangular blocky structure parting to weak fine granular; soft, very friable, nonsticky, and nonplastic; neutral; abrupt smooth boundary.

B2—8 to 14 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak medium and fine subangular blocky structure; soft, very friable, nonsticky, and nonplastic; neutral; clear smooth boundary.

B3—14 to 28 inches; brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; weak medium subangular blocky structure parting to single grain; soft, very

friable, nonsticky, and nonplastic; neutral; clear wavy boundary.

IIC1ca—28 to 36 inches; light yellowish brown (2.5Y 6/4) heavy loam, white (2.5Y 8/2) dry; weak medium platy structure parting to weak very fine subangular blocky; hard, friable, sticky, and plastic; about 2 percent pebbles and coarse fragments; violent effervescence; mildly alkaline; gradual wavy boundary.

IIC2—36 to 60 inches; light olive brown (2.5Y 5/4) heavy loam, pale yellow (2.5Y 7/4) dry; common medium prominent gray (5Y 5/1) and few fine distinct strong brown (7.5YR 5/6) mottles; weak medium platy structure parting to weak very fine subangular blocky; hard, friable, sticky, and plastic; about 2 percent pebbles and coarse fragments; strong effervescence; moderately alkaline.

The depth to the IIC horizon and to carbonates is 20 to 40 inches. The mollic epipedon is less than 16 inches thick.

The A horizon has hue of 10YR, value of 2 (3 or 4 dry), and chroma of 1.

The B horizon has hue of 10YR, value of 3 or 4 (4 through 6 dry), and chroma of 2 or 3. It is loamy sand or loamy fine sand.

The IIC horizon has hue of 2.5Y, value of 5 or 6 (6 through 8 dry), and chroma of 2 or 4. Typically, it is heavy loam, but the range includes clay loam, silt loam, or silty clay loam. Mottles range from none to common in the lower part. The IIC horizon contains less than 5 percent coarse fragments. Some pedons have a stone or pebble contact layer at the upper boundary of the IIC horizon.

Divide series

The Divide series consists of deep, somewhat poorly drained soils on stream terraces and outwash plains. These soils are moderately permeable in the upper part and very rapidly permeable in the underlying material. They are moderately deep over sand and gravel. These soils formed in loamy alluvium over sand and gravel. Slope is 1 to 3 percent.

Divide soils are similar to the Marysland soils and are near the Arvilla, Fordville, and Renshaw soils. Marysland soils are poorly drained and very poorly drained. Arvilla, Fordville, and Renshaw soils have a B2 horizon and are better drained.

Typical pedon from an area of Divide loam, 1 to 3 percent slopes, 265 feet west and 2,110 feet north of the southeast corner of sec. 23, T. 151 N., R. 66 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky, and slightly plas-

tic; about 2 percent pebbles; mildly alkaline; abrupt smooth boundary.

A12—7 to 10 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate fine granular; hard, friable, sticky, and plastic; about 2 percent pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

C1ca—10 to 20 inches; grayish brown (10YR 5/2) clay loam, light gray (10YR 7/1) dry; moderate coarse prismatic structure parting to moderate fine granular; hard, friable, sticky, and plastic; very dark gray (N 3/0) coatings on faces of peds; about 2 percent pebbles; violent effervescence; moderately alkaline; clear wavy boundary.

C2ca—20 to 22 inches; grayish brown (2.5Y 5/2) clay loam, light gray (2.5Y 7/2) dry; moderate medium subangular blocky structure parting to moderate fine granular; hard, friable, sticky, and plastic; about 2 percent pebbles; violent effervescence; moderately alkaline; gradual wavy boundary.

IIC3—22 to 30 inches; dark grayish brown (2.5Y 4/2) very gravelly sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky, and nonplastic; about 55 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

IIC4—30 to 36 inches; dark brown (10YR 4/3) gravelly coarse sand, brown (10YR 5/3) dry; single grain; loose, nonsticky, and nonplastic; about 30 percent gravel; slight effervescence; moderately alkaline; clear smooth boundary.

IIC5—36 to 42 inches; dark grayish brown (2.5Y 4/2) gravelly coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky, and nonplastic; about 45 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC6—42 to 60 inches; dark brown (10YR 4/3) gravelly coarse sand brown (10YR 5/3) dry; single grain; loose, nonsticky, and nonplastic; about 45 percent gravel; slight effervescence to strong effervescence; moderately alkaline.

The depth to the IIC horizon is 20 to 36 inches, but is typically 22 to 30 inches thick. Thickness of the mollic epipedon is 7 to 16 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 through 5 dry), and chroma of 1.

The Cca horizon has hue of 10YR or 2.5Y, value of 4 or 5 (6 or 7 dry), and chroma of 1 or 2. It is typically clay loam but ranges to loam. The Cca horizon has faint to distinct mottles in some pedons. In other pedons, crystals of calcium sulfate and other salts are in the Cca horizon. The IIC horizon has hue of 10YR or 2.5Y, value of 4 or 5 (5 or 6 dry), and chroma of 2 through 4. It is sand and gravel of granitic origin, but some is of shale origin. In some pedons, the sand and gravel is stratified.

Eckman series

The Eckman series consists of deep, well drained, moderately permeable soils on glacial lake plains and in small lake basins on glacial uplands. These soils formed in medium textured, calcareous lacustrine sediment. Slope is 3 to 15 percent.

Eckman soils are similar to the Gardena, Zell, and Great Bend soils and are near the Gardena, Glyndon, and Zell soils. Gardena soils have a mollic epipedon more than 16 inches thick. Zell soils have a thinner A horizon and have no B2 horizon. Great Bend soils have a fine-silty control section. Glyndon soils have no B2 horizon, have a calcic horizon at a depth of less than 16 inches; and are somewhat poorly drained.

Typical pedon of Eckman silt loam, from an area of Eckman-Zell silt loams, 6 to 9 percent slopes, 1,300 feet west and 490 feet south of the northeast corner of sec. 5, T. 153 N., R. 66 W.

- Ap—0 to 6 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; soft, friable, nonsticky, and slightly plastic; mildly alkaline; clear smooth boundary.
- A12—6 to 11 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium prismatic structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky, and slightly plastic; mildly alkaline; clear smooth boundary.
- B21—11 to 15 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky, and slightly plastic; mildly alkaline; clear wavy boundary.
- B22—15 to 22 inches; dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky, and slightly plastic; mildly alkaline; clear wavy boundary.
- B3—22 to 26 inches; dark grayish brown (2.5Y 4/2) silt loam, grayish brown (2.5Y 5/2) dry; weak medium prismatic structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky, and slightly plastic; slight effervescence; moderately alkaline; clear wavy boundary.
- C1ca—26 to 34 inches; light olive brown (2.5Y 5/4) silt loam, pale olive (5Y 6/3) dry; moderate fine subangular blocky structure; soft, friable, nonsticky, and slightly plastic; violent effervescence; moderately alkaline; clear wavy boundary.
- C2—34 to 60 inches; light olive brown (2.5Y 5/4) silt loam, pale olive (5Y 6/3) dry; massive; soft, friable, nonsticky, and slightly plastic; strong effervescence; moderately alkaline.

The depth to carbonates is 15 to 36 inches and the thickness of the solum is 15 to 44 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 through 5 dry), and a chroma of 1. It is 7 to 14 inches thick.

The B horizon has hue of 10YR or 2.5Y. It is 8 to 30 inches thick.

The C horizon has hue of 2.5Y, and it is 2.5Y or 5Y dry. In some pedons, the IIC horizon is silt, very fine sand, or fine sandy loam. Some pedons have sand, clay, or loam glacial till below a depth of 40 inches.

Edgeley variant

The Edgeley variant consists of deep, well drained, moderately permeable soils on glacial till plains, glacial moraines, and stream breaks. These soils formed in loamy glacial till which is moderately deep over unconsolidated shale. Slope is 15 to 60 percent.

The Edgeley variant is similar to the Barnes and Brantford soils, and is near the Bottineau, Aastad, and Buse soils. Barnes, Bottineau, Aastad, and Buse soils do not have large quantities of shale in the underlying material. Buse soils have a thinner A horizon. Bottineau soils have an argillic horizon, and Aastad soils have a mollic epipedon that is at least 16 inches thick. Brantford soils developed in glacial outwash and are fine-loamy over sandy or sandy-skeletal.

Typical pedon from an area of Edgeley Variant loam, 15 to 60 percent slopes, 900 feet east and 250 feet north of the southwest corner of sec. 11, T. 152 N., T. 65 W.

- A1—0 to 11 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium granular structure; slightly hard, friable, slightly sticky, and slightly plastic; neutral; about 4 percent shale fragments; clear wavy boundary.
- C1—11 to 24 inches; dark grayish brown (2.5Y 4/2) clay loam, grayish brown (10YR 5/2) dry; massive; slightly hard, firm, sticky, and plastic; slightly acid; about 10 percent shale fragments; gradual wavy boundary.
- IIC2—24 to 60 inches; dark olive gray (5Y 3/2) very shaly loam, olive gray (5Y 5/2) dry; massive; loose, slightly sticky, and slightly plastic; neutral; about 55 percent shale fragments.

The thickness of the A horizon is 10 to 20 inches. Some pedons have a B2 horizon. In some areas, Pierre shale is the parent material, while in other areas glacial till overlies the shale.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and a chroma of 1.

The C horizon has hue of 10YR through 5Y, value of 3 through 5, (5 through 7 dry), and chroma of 1 through 3. It is loam or clay loam in the upper part and very shaly loam or very shaly clay loam in the lower part.

Egeland series

The Egeland series consists of deep, well drained soils on sandy and loamy terraces and upland plains. Permeability of these soils is moderately rapid. These soils formed in sandy and loamy glacial outwash and lacustrine sediment. Slope is 1 to 6 percent.

Egeland soils are similar to the Embden soils and are near the Dickey, Embden, Hecla, Maddock, and Towner soils. Embden soils have a mollic epipedon more than 16 inches thick. Dickey, Hecla, Maddock, and Towner soils contain more sand in the solum.

Typical pedon of Egeland fine sandy loam, from an area of Embden-Egeland fine sandy loams, 1 to 6 percent slopes, 1,740 feet east and 1,425 feet south of the northwest corner of sec. 19, T. 156 N., R. 71 W.

- Ap—0 to 7 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, very friable, nonsticky, and slightly plastic; slightly acid; abrupt smooth boundary.
- B21—7 to 13 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky, and slightly plastic; slightly acid; gradual smooth boundary.
- B22—13 to 24 inches; olive brown (2.5Y 4/4) fine sandy loam, light olive brown (2.5Y 5/4) dry; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky, and slightly plastic; neutral; gradual smooth boundary.
- B3—24 to 31 inches; light olive brown (2.5Y 5/4) fine sandy loam, light yellowish brown (2.5Y 6/4) dry; weak coarse prismatic structure; slightly hard, very friable, nonsticky, and nonplastic; neutral; gradual wavy boundary.
- C1ca—31 to 46 inches; grayish brown (2.5Y 5/2) loamy fine sand, light brownish gray (2.5Y 6/2) dry; single grain; slightly hard, very friable and loose, nonsticky, and nonplastic; strong effervescence; mildly alkaline; gradual boundary.
- C2—46 to 60 inches; dark grayish brown (2.5Y 4/2) loamy fine sand, light brownish gray (2.5Y 6/2) dry; common medium faint gray (5Y 5/1) mottles; single grain; slightly hard, very friable and loose, nonsticky, and nonplastic; common medium soft masses of segregated lime; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to carbonates is typically 24 to 34 inches but ranges from 20 to 40 inches. Thickness of the mollic epipedon is 8 to 16 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. It is 6 to 8 inches thick.

The B2 horizon has hue of 10YR or 2.5Y, value of 3 or 4 (4 or 5 dry), and chroma of 2 through 4. It is sandy loam or fine sandy loam. Combined thickness of the B2 and B3 horizons is 14 to 32 inches.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5 (5 through 7 dry), and chroma of 2 through 4. It is fine sandy loam, loamy fine sand, or fine sand. Some pedons have a loamy IIC horizon below a depth of 40 inches.

Embden series

The Embden series consists of deep, moderately well drained soils on uplands. Permeability of these soils is moderately rapid. These soils formed in sandy and loamy outwash and lacustrine sediment. Slope is 1 to 9 percent.

Embden soils are similar to the Egeland soils and are near the Dickey, Egeland, Hecla, Maddock, and Towner soils. Egeland soils have a mollic epipedon less than 16 inches thick. Dickey, Hecla, Maddock, and Towner soils contain more sand in the solum.

Typical pedon of Embden fine sandy loam, from an area of Embden-Egeland fine sandy loams, 1 to 6 percent slopes, 1,800 feet east and 150 feet south of the northwest corner of sec. 30, T. 156 N., R. 71 W.

- A1—0 to 12 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; hard, very friable, slightly sticky, and slightly plastic; neutral; clear smooth boundary.
- B2—12 to 20 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak fine granular; hard, very friable, slightly sticky, and nonplastic; neutral; clear smooth boundary.
- B3—20 to 34 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; common fine distinct grayish brown (2.5Y 5/2) mottles; single grain; hard, very friable, nonsticky, and nonplastic; neutral; gradual boundary.
- C—34 to 60 inches; brown (10YR 5/3) loamy fine sand, pale brown (10YR 6/3) dry; single grain; slightly hard, loose, nonsticky, and nonplastic; neutral.

The thickness of the solum is 24 to 40 inches. Thickness of the mollic epipedon is 16 to 40 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. It is fine sandy loam, sandy loam, or loam and is 10 to 20 inches thick.

The B2 horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 2 or 3. It is fine sandy loam or sandy loam and is 6 to 20 inches thick. There is no B3 horizon in some pedons.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5 (5 or 6 dry), and chroma of 2 through 4. It is loamy fine sand, but ranges to fine sandy loam and sandy loam. In

some pedons, a Cca horizon is in the upper part of the C horizon. A loamy IIC horizon is below a depth of 40 inches in some pedons.

Emrick series

The Emrick series consists of deep, moderately well drained, moderately permeable soils on glacial uplands. These soils formed in loamy, calcareous glacial till. Slope is 1 to 9 percent.

Emrick soils are similar to the Embden, Gardena, and Svea soils and are near the Esmond, Fram, and Heimdal soils. Embden soils contain more sand. Gardena soils contain more silt and very fine sand. Svea soils contain more clay. Esmond soils have no B horizon. Fram soils have a calcic horizon within a depth of 16 inches. Heimdal soils have a mollic epipedon less than 16 inches thick.

Typical pedon of Emrick loam, from an area of Emrick-Heimdal loams, 1 to 3 percent slopes, 1,110 feet south and 700 feet east of the northwest corner of sec. 30, T. 155 N., R. 71 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium granular structure; soft, very friable, nonsticky, and nonplastic; neutral; abrupt smooth boundary.

A12—6 to 16 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium angular blocky structure; soft, very friable, nonsticky, and nonplastic; neutral; clear wavy boundary.

B21—16 to 23 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to moderate medium angular blocky; slightly hard, friable, nonsticky, and nonplastic; about 2 percent pebbles; neutral; clear wavy boundary.

B22—23 to 34 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to moderate medium angular blocky; slightly hard, friable, nonsticky, and nonplastic; about 2 percent pebbles; neutral; gradual wavy boundary.

C1ca—34 to 42 inches; light olive brown (2.5Y 5/4) loam, pale yellow (2.5Y 7/4) dry; weak medium angular blocky structure in the upper part and massive in the lower part; slightly hard, friable, nonsticky, and nonplastic; about 2 percent pebbles; strong effervescence; mildly alkaline; gradual wavy boundary.

C2ca—42 to 48 inches; light olive brown (2.5Y 5/4) loam, light gray (2.5Y 7/2) dry; massive; slightly hard, friable, nonsticky, and nonplastic; about 2 percent pebbles; violent effervescence; mildly alkaline; gradual wavy boundary.

C3—48 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; massive; slightly

hard, friable, nonsticky, and nonplastic; about 2 percent pebbles; strong effervescence; mildly alkaline.

The thickness of the solum, mollic epipedon, and the depth to carbonates is 16 to 36 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry) and chroma of 1. It is 8 to 18 inches thick.

The B2 horizon has hue of 10YR or 2.5Y, value of 3 or 4 (4 or 5 dry), and chroma of 2 or 3. It is 6 to 20 inches thick. In some pedons, the lower part of the B horizon and the C horizon are mottled.

The C horizon has hue of 2.5Y and 5Y, value of 4 through 6 (5 through 7 dry), and chroma of 2 through 4.

Esmond series

The Esmond series consists of deep, well drained, moderately permeable soils on convex slopes of glacial moraines and till plains. These soils formed in loamy calcareous glacial till. Slope is 6 to 40 percent.

Esmond soils are similar to the Buse soils and are near the Fram, Emrick, and Heimdal soils. Buse soils have more clay in the control section. Fram soils are somewhat poorly drained and have a calcic horizon. Emrick soils have a mollic epipedon more than 16 inches thick. Heimdal soils have a B2 horizon.

Typical pedon of Esmond loam, from an area of Heimdal-Esmond loams, 6 to 9 percent slopes, 1,700 feet south and 590 feet west of the northeast corner of sec. 22, T. 153 N., R. 69 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; soft, friable, slightly sticky, and slightly plastic; mildly alkaline; clear wavy boundary.

C1ca—9 to 16 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; weak, medium subangular blocky structure; soft, friable, slightly sticky, and slightly plastic; violent effervescence; mildly alkaline; gradual wavy boundary.

C2ca—16 to 23 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; weak medium and fine subangular blocky structure; soft, friable, slightly sticky, and slightly plastic; violent effervescence; moderately alkaline; gradual wavy boundary.

C3—23 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; massive; soft, friable, slightly sticky, and slightly plastic; strong effervescence; moderately alkaline.

The mollic epipedon is 7 to 10 inches thick. The 10- to 40-inch control section averages from 14 to 18 percent clay.

The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1. It is not effervescent or is slightly effervescent. Reaction is neutral or mildly alkaline. Some profiles have an AC horizon.

The Cca horizon has hue of 10YR or 2.5Y, value of 4 or 5 (5 through 7 dry), and chroma of 2 through 4. Some pedons have segregated lime in these horizons. The C horizon has hue of 2.5Y, value of 4 or 5 (5 through 7 dry), and chroma of 2 or 4. It is mildly alkaline or moderately alkaline.

Fargo series

The Fargo series consists of deep, poorly drained, slowly permeable soils in glacial lake basins. These soils formed in calcareous, clayey lacustrine sediments. Slope is 0 to 1 percent.

These soils do not have mottles directly below the mollic epipedon defined for the Fargo series. The difference does not alter the usefulness or behavior of the soils.

Fargo soils are similar to and are near the Grano and Hegne soils. Grano and Hegne soils have no B horizon.

Typical pedon from an area of Fargo silty clay loam, 1,410 feet east and 90 feet north of the southwest corner of sec. 13, T. 155 N., R. 67 W.

- Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; strong, very fine and fine granular structure; hard, firm, very sticky, and very plastic; neutral; abrupt smooth boundary.
- A12—9 to 12 inches; black (5Y 2/1) silty clay, dark gray (5Y 4/1) dry; weak medium prismatic structure parting to strong very fine angular blocky; very hard, firm, very sticky, and very plastic; mildly alkaline; abrupt irregular boundary.
- B21—12 to 22 inches; olive gray (5Y 4/2) clay, olive gray (5Y 5/2) dry; weak medium prismatic structure parting to strong very fine angular blocky; very hard, firm, very sticky, and very plastic; tongues of the A horizon extend into this horizon; slight effervescence; mildly alkaline; clear wavy boundary.
- B22—22 to 30 inches; olive gray (5Y 4/2) clay, olive gray (5Y 5/2) dry; many fine faint olive (5Y 5/3) mottles; weak medium prismatic structure parting to strong very fine angular blocky and subangular blocky; very hard, firm, very sticky, and very plastic; slight effervescence; moderately alkaline; gradual wavy boundary.
- C1gca—30 to 44 inches; olive gray (5Y 4/2) silty clay, light olive gray (5Y 6/2) dry; many fine and medium faint dark gray (5Y 4/1) and distinct yellowish brown (10YR 5/4) mottles; moderate very fine subangular blocky structure parting to moderate, very fine and fine granular; very hard, firm, very sticky, and very plastic; common nests and crystals of calcium sulfate; strong effervescence; moderately alkaline; gradual wavy boundary.
- C2g—44 to 60 inches; olive (5Y 4/3) and dark gray (5Y 4/1) silty clay, pale olive (5Y 6/3) dry; many medium distinct yellowish brown (10YR 5/4) mottles; mas-

sive, laminated with lenses of silty material; very hard, firm, very sticky, and very plastic; common nests and crystals of calcium sulfate; strong effervescence; mildly alkaline.

The thickness of the solum is 16 to 36 inches. Thickness of the mollic epipedon is 8 to 24 inches. Depth to carbonates is 11 to 24 inches.

The A horizon has hue of 10YR through 5Y, value of 2 (3 or 4 dry), and chroma of 1; or it is N 2/0 (N 3/0 or N 4/0 dry). It is 7 to 15 inches thick.

The B2 horizon has hue of 2.5Y or 5Y, value of 2 through 4 (3 through 5 dry), and chroma of 1 or 2. It is silty clay or clay and is 12 to 25 inches thick.

The Cg horizon has hue of 2.5Y or 5Y, value of 4 or 5 (6 or 7 dry), and chroma of 1 through 3. It is silty clay or clay in the upper part and laminated silty clay loam, silty clay, or clay in the lower part. Lime accumulation is in the upper part of the horizon. Mottles range from common to many.

Fordville series

The Fordville series consists of deep, well drained soils on stream terraces and outwash plains. These soils are moderately permeable in the upper part and rapidly permeable in the underlying material. They are moderately deep over sand and gravel. These soils formed in loamy alluvium over stratified sand and gravel. Slope is 1 to 3 percent.

Fordville soils are similar to the Arvilla, Brantford, Renshaw, and Vang soils, and are near the Arvilla, Divide, Renshaw, and Sioux soils. Arvilla, Brantford, Renshaw, and Sioux soils have a mollic epipedon less than 16 inches thick. Sioux soils have sand and gravel at a depth of less than 14 inches. Vang soils have 50 percent or more coarse shale fragments in the IIC horizon. Divide soils are somewhat poorly drained and have a calcic horizon within a depth of 16 inches.

Typical pedon from an area of Fordville loam, 1 to 3 percent slopes, 2,500 feet north and 190 feet east of the southwest corner of sec. 9, T. 152 N., R. 71 W.

- Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium granular structure; slightly hard, very friable, slightly sticky, and slightly plastic; neutral; abrupt smooth boundary.
- A12—7 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to moderate medium granular; slightly hard, very friable, slightly sticky, and slightly plastic; neutral; clear wavy boundary.
- B21—10 to 17 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; hard, very friable, slightly

sticky, and slightly plastic; neutral; clear wavy boundary.

B22—17 to 20 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky, and slightly plastic; mildly alkaline; clear wavy boundary.

IIC1ca—20 to 24 inches; dark grayish brown (10YR 4/2) coarse sandy loam, pale brown (10YR 6/3) dry; single grain; loose, nonsticky, and nonplastic; about 10 percent gravel; many medium soft masses of lime; violent effervescence; mildly alkaline; gradual wavy boundary.

IIC2—24 to 36 inches; grayish brown (10YR 5/2) sand and gravel, pale brown (10YR 6/3) dry; single grain; loose, nonsticky, and nonplastic; about 15 percent gravel; thin lime crusts on the underside of pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

IIC3—36 to 47 inches; grayish brown (2.5Y 5/2) sand and gravel, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky, and nonplastic; about 10 percent gravel; strong effervescence; mildly alkaline; gradual wavy boundary.

IIC4—47 to 60 inches; dark grayish brown (2.5Y 4/2) sand and gravel, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky, and nonplastic; about 10 percent gravel; slight effervescence; mildly alkaline.

The depth to sand and gravel and carbonates is 20 to 26 inches, but the range includes 20 to 40 inches. Thickness of the mollic epipedon is 16 to 26 inches and includes all or most of the B horizon.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry); and chroma of 1. It is 6 to 10 inches thick.

The B2 horizon has hue of 10YR, value of 3 or 4 (4 or 5 dry), and chroma of 2 or 3. It is 9 to 16 inches thick. Some pedons have a B3 horizon.

The IIC horizon has hue of 10YR or 2.5Y, value of 4 or 5 (5 or 6 dry), and chroma of 2 or 3.

Fossum series

The Fossum series consists of deep, poorly drained, rapidly permeable soils on glacial lake and outwash plains. These soils formed in loamy and sandy outwash and lacustrine sediment. Slope is 0 to 1 percent.

Fossum soils are near the Hecla and Maddock soils. Hecla soils are moderately well drained and Maddock soils are well drained. In addition, these soils are not calcareous to the surface.

Typical pedon from an area of Fossum fine sandy loam, 320 feet east and 235 feet north of the southeast corner of sec. 12, T. 156 N., R. 71 W.

A11—0 to 8 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak medium and coarse subangular blocky structure parting to weak fine subangular blocky; soft, very friable, nonsticky, and slightly plastic; slight effervescence; moderately alkaline; clear smooth boundary.

A12—8 to 12 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium and coarse subangular blocky structure parting to weak fine subangular blocky; soft, very friable, nonsticky, and slightly plastic; strong effervescence; moderately alkaline; diffuse wavy boundary.

A13—12 to 19 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak fine and medium subangular blocky structure; soft, very friable, nonsticky, and slightly plastic; strong effervescence; moderately alkaline; clear wavy boundary.

C1—19 to 33 inches; dark grayish brown (2.5Y 4/2) loamy fine sand, grayish brown (2.5Y 5/2) dry; common medium distinct olive brown (2.5Y 4/4) mottles; massive; soft, very friable, nonsticky, and nonplastic; strong effervescence; moderately alkaline; clear wavy boundary.

C2—33 to 48 inches; grayish brown (2.5Y 5/2) loamy fine sand, light brownish gray (2.5Y 6/2) dry; common medium distinct olive brown (2.5Y 4/4) mottles; massive; soft, very friable, nonsticky, and nonplastic; strong effervescence; moderately alkaline; clear wavy boundary.

C3—48 to 60 inches; olive (5Y 4/3) loamy fine sand, olive (5Y 5/3) dry; common medium prominent yellowish brown (10YR 5/6) mottles; massive; soft, very friable, nonsticky, and nonplastic; mildly alkaline.

The thickness of the mollic epipedon is 10 to 24 inches.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. Some pedons have mottles in the lower part of the A horizon. Some pedons have textures coarser than loamy fine sand in the lower part of the A horizon.

The C horizon has hue of 2.5Y or 5Y, value of 4 through 6, and chroma of 1 through 3. It has few to many mottles. The C horizon is typically loamy fine sand; but sand, fine sand, and loamy sand are in the range.

Fram series

The Fram series consists of deep, somewhat poorly drained, moderately permeable soils on glacial till plains that have numerous depressions. These soils formed in loamy glacial till. Slope is 1 to 3 percent.

Fram soils are similar to the Hamerly soils and are near the Cathay, Emrick, Heimdal, Larson, and Vallers soil. Hamerly and Vallers soils contain 18 to 34 percent

clay in the control section. Cathay and Larson soils have a natric horizon. Emrick and Heimdal soils have a B horizon and are on higher lying positions in the landscape.

Typical pedon of Fram loam, from an area of Fram-Emrick loams, 1 to 3 percent slopes, 1,374 feet east and 260 feet south of the northwest corner of sec. 9, T. 151 N., R. 67 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine and fine granular structure; slightly hard, very friable, slightly sticky, and slightly plastic; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12ca—10 to 13 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; few fine distinct grayish brown (2.5Y 5/2) mottles; weak coarse subangular blocky structure parting to weak very fine and fine granular; slightly hard, very friable, slightly sticky, and plastic; strong effervescence; mildly alkaline; clear wavy boundary.

C1ca—13 to 27 inches; grayish brown (2.5Y 5/2) loam, light brownish gray (2.5Y 6/2) dry; few fine faint dark grayish brown (2.5Y 4/2) mottles; weak coarse subangular blocky structure; slightly hard, very friable, sticky, and plastic; few threads of gypsum; 2 to 5 percent pebbles; violent effervescence; mildly alkaline; clear wavy boundary.

C2—27 to 38 inches; light olive brown (2.5Y 5/4) loam, pale yellow (2.5Y 7/4) dry; weak coarse subangular blocky structure parting to weak medium platy; hard, very friable, slightly sticky, and slightly plastic; strong effervescence; moderately alkaline; clear wavy boundary.

C3—38 to 60 inches; olive brown (2.5Y 4/4) loam, light brownish gray (2.5Y 6/2) dry; few fine distinct grayish brown (2.5Y 5/2) mottles; hard, friable, slightly sticky, and slightly plastic; 2 to 5 percent pebbles and shale fragments; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon is 7 to 16 inches. The pedon contains up to 10 percent coarse fragments. Some pedons are saline.

The A horizon has hue of 10YR, value of 2 or 3 (3 through 5 dry), and chroma of 1.

The Cca horizon has hue of 2.5Y, value of 4 through 6 (5 through 7 dry), and chroma of 2. Mottles range from none to few. Some pedons have a layer of sand, gravel, or stones at a depth of 20 to 40 inches. The C horizon has hue of 2.5Y, value of 4 or 5 (6 or 7 dry), and chroma of 2 or 4. Mottles range from none to common.

Gardena series

The Gardena series consists of deep, moderately well drained, moderately permeable soils on glacial lake

plains and in small lake basins on glacial uplands. These soils formed in medium textured, calcareous lacustrine sediment. Slope is 1 to 6 percent.

Gardena soils are similar to the Glyndon soils and are near the Borup and Glyndon soils. The poorly drained Borup soils and the somewhat poorly drained Glyndon soils do not have a B horizon but have a calcic horizon within a depth of 16 inches.

Typical pedon from an area of Gardena silt loam, 1 to 3 percent slopes, 1,310 feet south and 280 feet west of the northeast corner of sec. 5, T. 153 N., R. 66 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, nonsticky, and slightly plastic; mildly alkaline; abrupt smooth boundary.

A12—7 to 15 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, nonsticky, and slightly plastic; mildly alkaline; clear wavy boundary.

B21—15 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, nonsticky, and slightly plastic; moderately alkaline; gradual wavy boundary.

B22—18 to 21 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, nonsticky, and slightly plastic; moderately alkaline; clear wavy boundary.

C1ca—21 to 28 inches; light olive brown (2.5Y 5/4) silt loam, pale yellow (2.5Y 7/4) dry; weak fine and medium subangular blocky structure; slightly hard, friable, nonsticky, and slightly plastic; violently effervescent; moderately alkaline; gradual wavy boundary.

C2ca—28 to 41 inches; light olive brown (2.5Y 5/4) silt loam, pale yellow (2.5Y 7/4) dry; massive; slightly hard, friable, nonsticky, and slightly plastic; violent effervescence; moderately alkaline; gradual wavy boundary.

C3—41 to 60 inches; olive (5Y 5/3) silt loam, pale yellow (5Y 7/3) dry; massive; slightly hard, friable, nonsticky, and slightly plastic; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates is 18 to 36 inches. Thickness of the mollic epipedon is 16 to 30 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. It is 12 to 20 inches thick.

The B2 horizon has hue of 10YR, value of 3 or 4 (4 or 5 dry), and chroma of 2 or 3. It is 6 to 16 inches thick.

The Cca horizon has hue of 2.5Y, value of 4 or 5 (6 or 7 dry), and chroma of 2 or 4. In some pedons, there is no Cca horizon. The lower part of the C horizon has hue of 2.5Y or 5Y, value of 4 or 5 (6 or 7 dry), and chroma of 2 through 4. It is silt loam, but some pedons have loam below a depth of 40 inches. Mottles range from none to many.

Glyndon series

The Glyndon series consists of deep, somewhat poorly drained, soils on glacial lake plains. These soils are moderately permeable in the upper part of the profile and rapidly permeable in the lower part. They formed in medium textured, calcareous lacustrine sediment. Slope is 0 to 1 percent.

Glyndon soils are similar to Borup and Gardena soils, and are near Borup, Gardena, and Marysland soils. Borup soils are poorly drained. Gardena soils have a B horizon but do not have a calcic horizon within a depth of 16 inches. Marysland soils are very poorly drained or poorly drained and have a sand and gravel IIC horizon at a depth of 20 to 40 inches.

Typical pedon from an area of Glyndon silt loam, 1,490 feet north and 1,380 feet east of the southwest corner of sec. 13, T. 156 N., R. 67 W.

- Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, very friable, slightly sticky, and slightly plastic; slight effervescence; mildly alkaline; abrupt smooth boundary.
- A12—8 to 14 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; common fine prominent olive brown (2.5Y 4/4) mottles; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky, and slightly plastic; strong effervescence; mildly alkaline; clear wavy boundary.
- C1ca—14 to 29 inches; light brownish gray (2.5Y 6/2) silt loam, white (2.5Y 8/2) dry; common fine distinct light olive brown (2.5Y 5/4) mottles; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky, and slightly plastic; violent effervescence; moderately alkaline; gradual wavy boundary.
- C2—29 to 46 inches; light yellowish brown (2.5Y 6/4) very fine sandy loam, pale yellow (2.5Y 7/4) dry; common fine distinct grayish brown (2.5Y 5/2) mottles; massive; slightly hard, very friable, slightly sticky, and slightly plastic; strong effervescence; moderately alkaline; gradual wavy boundary.
- C3g—46 to 60 inches; multicolored stratified silt loam and loamy very fine sand; massive; hard, very friable, slightly sticky, and slightly plastic; strong effervescence; mildly alkaline.

The thickness of the mollic epipedon is 7 to 16 inches. Depth to the calcic horizon is less than 16 inches.

The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2.

The Cca horizon has hue of 10YR or 2.5Y, value of 4 through 6 (6 through 8 dry), and chroma of 2. It is typically silt loam but range includes loam and very fine sandy loam. Mottles range from none to common. The C horizon is stratified silt loam and loamy very fine sand, but the range includes very fine sandy loam or loam. A few pedons contain fine sand below a depth of 40 inches.

Grano series

The Grano series consists of deep, poorly drained and very poorly drained, slowly permeable soils in shallow, closed depressions on glacial lake plains and till plains. These soils formed in clayey, calcareous lacustrine sediment. Slope is 0 to 1 percent.

Grano soils are similar to the Fargo and Hegne soils and are near the Parnell and Vallers soils. Fargo and Parnell soils have a B horizon. Hegne and Vallers soils have a calcic horizon within a depth of 16 inches. Vallers soils contain less than 35 percent clay in the control section.

Typical pedon from an area of Grano silty clay, 640 feet west and 140 feet south of the northeast corner of sec. 36, T. 155 N., R. 67 W.

- Ap—0 to 10 inches; black (5Y 2/1) silty clay, very dark gray (5Y 3/1) dry; moderate very fine and fine granular structure; hard, firm, very sticky, and very plastic; slight effervescence; mildly alkaline; abrupt smooth boundary.
- C1g—10 to 20 inches; very dark gray (5Y 3/1) and dark gray (5Y 4/1) clay, gray (5Y 5/1 and 5Y 6/1) dry; weak medium and coarse prismatic structure parting to moderate very fine subangular blocky and granular; extremely hard, firm, very sticky, and very plastic; strong effervescence; mildly alkaline; clear wavy boundary.
- C2g—20 to 42 inches; dark gray (5Y 4/1) clay, gray (5Y 6/1) dry; moderate very fine subangular blocky and granular structure; extremely hard, firm, very sticky, and very plastic; strong effervescence; mildly alkaline; gradual wavy boundary.
- C3g—42 to 60 inches; olive gray (5Y 4/2) clay, gray (5Y 6/1) dry; many fine faint olive (5Y 4/3) mottles; massive; hard, firm, very sticky, and very plastic; strong effervescence; mildly alkaline.

The thickness of the solum is 8 to 16 inches. The mollic epipedon is 8 to 24 inches thick. Reaction is mildly alkaline or moderately alkaline. Some pedons are saline.

The A horizon has hue of 5Y, value of 2 or 3 (3 or 4 dry), and chroma of 1. In some pedons, the A horizon boundary tongues into the Cg horizon.

The Cg horizon has hue of 5Y, value of 3 through 5 (5 through 7 dry), and chroma of 1 through 3. It is silty clay or clay. Mottles range from few to many. Some pedons have crystals of gypsum. The IIC horizon of loam glacial till is below a depth of 40 inches in some pedons.

Great Bend series

The Great Bend series consists of deep, well drained soils on glacial lake plains and in small lake basins on glacial uplands. Permeability of these soils is moderately slow. These soils formed in silty, calcareous glacial lacustrine sediment. Slope is 3 to 6 percent.

Great Bend soils are similar to the Eckman and Overly soils and are near the Overly, Bearden, and Colvin soils. Eckman soils have a coarse silty control section. Overly soils have a mollic epipedon more than 16 inches thick. Bearden and Colvin soils are somewhat poorly drained and poorly drained, respectively. In addition, these soils have a calcic horizon within a depth of 16 inches.

Typical pedon from an area of Great Bend silt loam, 3 to 6 percent slopes, 1,710 feet east and 1,660 feet south of the northwest corner of sec. 23, T. 153 N., R. 66 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium and fine granular structure; soft, friable, sticky, and slightly plastic; mildly alkaline; abrupt smooth boundary.

A12—7 to 9 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, sticky, and slightly plastic; mildly alkaline; clear smooth boundary.

B21—9 to 13 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate medium and fine angular blocky; slightly hard, firm, sticky, and slightly plastic; moderately alkaline; clear smooth boundary.

B22—13 to 15 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate medium angular blocky; slightly hard, firm, sticky, and slightly plastic; moderately alkaline; abrupt smooth boundary.

C1ca—15 to 19 inches; olive brown (2.5Y 4/4) silty clay loam, light brownish gray (2.5Y 6/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, firm, sticky, and slightly plastic; violent effervescence; strongly effervescent lime in common fine and medium irregularly shaped filaments and soft masses; moderately alkaline; clear smooth boundary.

C2ca—19 to 25 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; weak medium prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, firm, sticky, and slightly plastic; violent effervescence, strongly effervescent lime in common fine and medium irregularly shaped filaments and soft masses; very strongly alkaline; clear wavy boundary.

C3—25 to 36 inches; light olive brown (2.5Y 5/4) silt loam, pale yellow (2.5Y 8/4) dry; massive; soft, friable, slightly sticky, and slightly plastic; strong effervescence; strongly alkaline; clear wavy boundary.

C4—36 to 60 inches; light olive brown (2.5Y 5/4) silt loam, pale yellow (2.5Y 8/4) dry; massive; soft, friable, slightly sticky, and slightly plastic; slight effervescence; strongly alkaline.

The thickness of the solum is 12 to 24 inches. The thickness of the mollic epipedon is 6 to 16 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 through 5 dry), and chroma of 1. It is 5 to 10 inches thick and is mostly free of coarse fragments.

The B horizon has hue of 10YR or 2.5Y, value of 3 through 5 (4 through 6 dry), and chroma of 2 through 4. It is typically silty clay loam, but silt loam is in the range. The B horizon is 6 to 12 inches thick. Some pedons have a B3 horizon.

The C horizon has hue of 2.5Y, value of 4 through 6 (6 through 8 dry), and chroma of 2 through 4. Lenses of silt, clay, or very fine sand are below a depth of 40 inches. Lime is segregated or disseminated.

Hamerly series

The Hamerly series consists of deep, somewhat poorly drained soils on glacial till plains. Permeability of these soils is moderately slow. These soils formed in loamy, calcareous glacial till. Slope is 0 to 6 percent.

Hamerly soils are similar to the Fram and Vallers soils and are near the Barnes, Svea, Tonka, and Vallers soils. Fram soils have less than 18 percent clay in the control section. Vallers and Tonka soils are poorly drained. Tonka soils have a B horizon. Barnes and Svea soils have a B horizon and are on higher lying positions in the landscape.

Typical pedon of Hamerly loam, from an area of Hamerly Tonka loams, 0 to 3 percent slopes, 2,540 feet east and 380 feet south of the northwest corner of sec. 18, T. 156 N., R. 68 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine granular structure; slightly hard, friable, slightly sticky, and plastic; about 2 percent pebbles and coarse fragments; strong effervescence; mildly alkaline; abrupt smooth boundary.

A12ca—8 to 9 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak very fine granular structure; hard, friable, slightly sticky, and plastic; about 2 percent pebbles and coarse fragments; violent effervescence; mildly alkaline; clear broken boundary.

C1ca—9 to 16 inches; grayish brown (2.5Y 5/2) clay loam, light gray (2.5Y 7/2) dry; common fine distinct light olive brown (2.5Y 5/4) mottles; weak coarse prismatic structure parting to weak very fine subangular blocky; hard, friable, sticky, and plastic; very dark gray (N 3/0) streaks and fine tongues; about 5 percent pebbles and coarse fragments; violent effervescence; mildly alkaline; gradual wavy boundary.

C2ca—16 to 22 inches; brown (10YR 5/3) clay loam, light gray (2.5Y 7/2) dry; weak coarse prismatic structure parting to weak very fine subangular blocky; hard, friable, sticky, and plastic; about 5 percent pebbles and coarse fragments; violent effervescence; moderately alkaline; clear wavy boundary.

C3—22 to 60 inches; light olive brown (2.5Y 5/4) loam, light brownish gray (2.5Y 6/2) dry; common medium prominent gray (5Y 5/1) and few fine distinct strong brown (7.5YR 5/6) mottles; massive; hard, friable, slightly sticky, and plastic; about 5 percent pebbles and angular coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum and the mollic epipedon is 6 to 15 inches. Depth to the calcic horizon is less than 16 inches. The profile contains 1 to 10 percent coarse fragments. Some pedons are saline.

The A horizon has hue of 10YR, value of 2 or 3 (3 through 5 dry), and chroma of 1.

The Cca horizon has hue of 10YR or 2.5Y, value of 4 through 6 (6 through 8 dry), and chroma of 2 through 4. It is loam or clay loam. In some pedons there are few or common crystals of calcium sulfate. The C horizon has hue of 2.5Y, value of 4 through 6 (6 through 8 dry), and chroma of 2 or 4. It is loam or clay loam. Mottles range from faint to prominent and are few or common.

Hecla series

The Hecla series consists of deep, moderately well drained, rapidly permeable soils on sandy uplands. These soils formed in eolian sands. Slope is 1 to 6 percent.

Hecla soils are similar to the Dickey, Fossum, Maddock, and Towner soils and are near the Dickey, Egeland, Embden, Fossum, Maddock, and Towner soils. Dickey and Towner soils have loam or clay loam in the lower part of the C horizon. Fossum soils are poorly drained. Maddock soils have a thinner mollic epipedon and are well drained. Egeland and Embden soils have a loam or fine sandy loam control section.

Typical pedon of Hecla loamy fine sand, from an area of Hecla-Maddock loamy fine sands, 1 to 3 percent

slopes, 2,540 feet west and 1,200 feet south of the northeast corner of sec. 7, T. 156 N., R. 71 W.

A11—0 to 12 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; single grain; loose, nonsticky, and nonplastic; neutral; clear smooth boundary.

A12—12 to 26 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak medium and coarse prismatic structure; loose, nonsticky, and nonplastic; neutral; clear smooth boundary.

C1—26 to 44 inches; brown (10YR 5/3) fine sand, pale brown (10YR 6/3) dry; common fine faint grayish brown (10YR 5/2) mottles; single grain; loose, nonsticky, and nonplastic; neutral; gradual wavy boundary.

C2—44 to 54 inches; light olive brown (2.5Y 5/4) fine sand, light yellowish brown (2.5Y 6/4) dry; common fine distinct grayish brown (2.5Y 5/2) mottles; single grain; loose, nonsticky, and nonplastic; slight effervescence; mildly alkaline; gradual wavy boundary.

C3—54 to 60 inches; light olive brown (2.5Y 5/4) fine sand, light yellowish brown (2.5Y 6/4) dry; common medium prominent gray (5Y 5/1) and common medium distinct strong brown (7.5Y 5/6) mottles; single grain; loose, nonsticky, and nonplastic; slight effervescence; mildly alkaline.

The thickness of the solum is 16 to 40 inches. Thickness of the mollic epipedon is 10 to 20 inches. Depth to carbonates is more than 20 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1 or 2. It is loamy fine sand, but in some pedons it is fine sandy loam to a depth of 10 inches. Some pedons have an AC horizon. In other pedons, the lower part of the A horizon and the AC horizon, where present, have faint mottles.

The C horizon has hue of 10YR or 2.5Y, value of 4 or 5 (5 or 6 dry), and chroma of 2 through 4. It is loamy fine sand or fine sand. Some pedons have loam glacial till below a depth of 40 inches.

Hegne series

The Hegne series consists of deep, poorly drained, very slowly permeable soils on glacial lake plains and basins. These soils formed in clayey, calcareous lacustrine sediment. Slope is 0 to 1 percent.

Hegne soils are similar to the Fargo and Grano soils and are near the Fargo and Grano soils. Fargo and Grano soils do not have a calcic horizon within a depth of 16 inches. In addition, Fargo soils have a B horizon.

Typical pedon from an area of Hegne silty clay, 810 feet west and 120 feet south of the northeast corner of sec. 1, T. 155 N., R. 67 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate very fine granular structure; very hard, friable, very sticky, and very plastic; strong effervescence; mildly alkaline; abrupt smooth boundary.

AC—8 to 10 inches; very dark gray (10YR 3/1) and dark gray (10YR 4/1) silty clay, gray (10YR 5/1) and light gray (10YR 6/1) dry; moderate very fine subangular blocky structure; very hard, firm, very sticky, and very plastic; strong effervescence; mildly alkaline; clear broken boundary.

C1gca—10 to 24 inches; gray (5Y 5/1) silty clay, light gray (5Y 6/1) dry; few fine distinct brown (10YR 5/3) mottles; moderate very fine subangular blocky structure; very hard, firm, very sticky, and very plastic; few tongues and streaks of the A horizon extend to 16 inches; violent effervescence; moderately alkaline; clear wavy boundary.

C2g—24 to 42 inches; olive gray (5Y 5/2) silty clay, light olive gray (5Y 6/2) dry; many fine distinct olive (5Y 5/4) and common fine distinct brown (10YR 5/3) mottles; moderate very fine subangular blocky structure; very hard, firm, very sticky, and very plastic; few crystals of calcium sulfate; strong effervescence; moderately alkaline; gradual wavy boundary.

C3g—42 to 60 inches; olive gray (5Y 5/2) and dark gray (5Y 4/1) clay, light olive gray (5Y 6/2) and gray (5Y 5/1 and 6/1) dry; massive, varved with lenses of silt; very hard, very firm, very sticky, and very plastic; few crystals and nests of calcium sulfate; strong effervescence; moderately alkaline.

The thickness of the solum and the mollic epipedon is 7 to 16 inches. Depth to the calcic horizon is less than 16 inches.

The A horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1; or it is N 2/0 or N 3/0 (N 4/0 or N 5/0 dry). The AC horizon has hue of 10YR, value of 3 or 4 (5 or 6 dry), and chroma of 1, or is N 3/0 or N 4/0 (N 5/0 or N 6/0 dry). It is clay or silty clay. Some pedons have no AC horizon.

The C horizon has hue of 2.5Y or 5Y, value of 4 or 5 (5 or 6 dry), and chroma of 1 or 2.

Heimdal series

The Heimdal series consists of deep, well drained, moderately permeable soils on glacial uplands. These soils formed in calcareous glacial till. Slope is 1 to 40 percent.

Heimdal soils are similar to the Barnes, Eckman, Emrick, and Esmond soils and are near the Emrick, Esmond, and Fram soils. Barnes soils have a higher clay content. Eckman soils have more silt and very fine sand. Emrick soils have a mollic epipedon more than 16 inches thick. Esmond soils have no B horizon. Fram soils have a calcic horizon at a depth of 16 inches.

Typical pedon of Heimdal loam, from an area of Heimdal-Emrick loams, 3 to 6 percent slopes, 2,475 feet east and 110 feet south of the northeast corner of sec. 17, T. 154 N., R. 71 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, nonsticky, and slightly plastic; neutral; abrupt smooth boundary.

A12—6 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; slightly hard, friable, nonsticky, and slightly plastic; mildly alkaline; clear wavy boundary.

B21—8 to 13 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry, weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, nonsticky, and slightly plastic; neutral; clear wavy boundary.

B22—13 to 19 inches; dark brown or brown (10YR 4/3) loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, nonsticky, and slightly plastic; mildly alkaline; clear wavy boundary.

C1ca—19 to 31 inches; grayish brown (2.5Y 5/2) loam, light gray (2.5Y 7/2) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; about 5 percent gravel; violent effervescence; moderately alkaline; gradual irregular boundary.

C2—31 to 42 inches; yellowish brown (2.5Y 5/4) loam, pale yellow (2.5Y 7/4) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; about 5 percent gravel; strong effervescence; moderately alkaline; gradual irregular boundary.

C3—42 to 60 inches; yellowish brown (2.5Y 5/4) light sandy clay loam, pale yellow (2.5Y 7/4) dry; massive; slightly hard, friable, slightly sticky, and slightly plastic; about 5 percent gravel, slight effervescence; moderately alkaline.

The thickness of the solum and depth to carbonates is 12 to 20 inches. Thickness of the mollic epipedon is 7 to 16 inches. Some pedons do not have gravel, and other pedons have a layer of pebbles as much as 3 inches thick.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. It is 5 to 9 inches thick. The B horizon has hue of 10YR, value of 3 or 4 (4 through 6 dry), and chroma of 2 or 3. It is 6 to 16 inches thick.

The Cca and C horizons have hue of 2.5Y, value of 4 or 5 (6 or 7 dry), and chroma of 2 through 4. Some pedons have stratified sandy loam, silt loam, or gravelly loam in the lower part of the C horizon.

LaDelle series

The LaDelle series consists of deep, moderately well drained, moderately permeable soils on bottom lands. These soils formed in silty alluvium. Slope is 0 to 1 percent.

LaDelle soils are similar to the Lamoure soils and are near the Aberdeen, Lamoure, Rauville, and Ryan soils. Lamoure soils are poorly drained. Aberdeen and Ryan soils have a natric horizon. Rauville soils are very poorly drained.

Typical pedon from an area of LaDelle silt loam 2,530 feet east and 610 feet north of the southwest corner of sec. 7, T. 151 N., R. 68 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; slightly hard, friable, sticky, and plastic; neutral; abrupt smooth boundary.

A12—7 to 17 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium prismatic structure parting to moderate fine angular blocky; slightly hard, friable, sticky, and plastic; mildly alkaline; clear smooth boundary.

B2—17 to 27 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate medium prismatic structure parting to weak medium angular blocky; hard, friable, sticky, and plastic; few fine threads of segregated lime; slight effervescence; mildly alkaline; clear smooth boundary.

C1—27 to 42 inches; dark gray (10YR 4/1) silt loam, light brownish gray (10YR 6/2) dry; weak medium prismatic structure parting to weak fine subangular blocky; hard, friable, sticky, and plastic; common fine threads of segregated lime; strong effervescence; moderately alkaline; clear smooth boundary.

A1b—42 to 46 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; weak medium prismatic structure; hard, firm, sticky, and plastic; many fine soft masses of segregated lime; about 1 percent pebbles; strong effervescence; moderately alkaline; clear smooth boundary.

C2—46 to 60 inches; gray brown (2.5Y 5/2) clay loam, light brownish gray (2.5Y 6/2) dry; massive; very hard, firm, sticky, and plastic; about 1 percent pebbles; strong effervescence; moderately alkaline.

The thickness of the solum is 22 to 40 inches. Depth to carbonates is 0 to 20 inches. Thickness of the mollic epipedon is 20 to 40 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. It is 14 to 22 inches thick.

The B2 horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2. It is mainly silt loam, but the range includes loam and silty clay loam. The B2 horizon is 8 to 14 inches thick.

The C horizon has hue of 10YR or 2.5Y, value of 3 through 5 (4 through 7 dry), and chroma of 1 or 2. It is loam, clay loam, silt loam, or silty clay loam. Some pedons have a sandy layer below a depth of 40 inches.

Lallie series

The Lallie series consists of deep, poorly drained and very poorly drained, slowly permeable soils in lake basins. These soils formed in clayey lacustrine sediment. Slope is 0 to 1 percent.

Lallie soils are similar to the Grano soils and are near the Colvin and Minnewaukan soils. Grano and Colvin soils have a mollic epipedon. In addition, Colvin soils have a calcic horizon within a depth of 16 inches. Minnewaukan soils are sandy throughout.

Typical pedon from an area of Lallie loam, 150 feet west and 110 feet north of the southeast corner of sec. 12, T. 153 N., R. 66 W.

Al—0 to 2 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure parting to weak very fine granular; slightly hard, friable, slightly sticky, and nonplastic; slight effervescence; mildly alkaline; abrupt smooth boundary.

Clg—2 to 25 inches; gray (5Y 5/1) silty clay, light gray (5Y 7/1) dry; weak medium prismatic structure parting to strong fine angular blocky; hard, very firm, very sticky, and very plastic; strong effervescence; moderately alkaline; gradual wavy boundary.

C2g—25 to 31 inches; grayish brown (2.5Y 5/2) and dark gray (5Y 4/1) and gray (5Y 5/1) silty clay, light gray (2.5Y 7/2 and 5Y 6/1) and gray (5Y 5/1) dry; few fine prominent light yellowish brown (10YR 6/4) mottles; laminated, massive; hard, very firm, very sticky, and very plastic; strong effervescence; moderately alkaline; gradual smooth boundary.

C3gcs—31 to 42 inches; olive (5Y 5/3) silty clay, pale yellow (5Y 7/3) dry; common medium distinct light brownish gray (2.5Y 6/2) and few fine prominent dark yellowish brown (10YR 3/4) mottles; laminated, massive; hard, very firm, very sticky, and very plastic; strong effervescence; few nests of gypsum crystals; moderately alkaline; gradual wavy boundary.

C4g—42 to 60 inches; light olive brown (2.5Y 5/4) silty clay, pale yellow (2.5Y 7/4) dry; common medium distinct light brownish gray (2.5Y 6/2) mottles; laminated, massive; hard, very firm, very sticky, and very plastic; strong effervescence; moderately alkaline.

Some pedons are saline. The A horizon has hue of 10YR through 5Y, value of 2 through 4 (3 through 6 dry), and chroma of 1 or 2. It is typically loam, but ranges to silty clay and sandy loam. It is 1 to 5 inches thick. The Cg horizon has hue of 2.5Y or 5Y, value of 3 through 5 (5 through 7 dry), and chroma of 1 through 4. Some

pedons have a buried A horizon. Some pedon contain layers of coarser material below a depth of 40 inches.

Lamoure series

The Lamoure series consists of deep, poorly drained, moderately permeable soils on bottom lands. These soils formed in silty alluvium. Slope is 0 to 1 percent.

These soils do not have the colors directly below the mollic epipedon defined for the Lamoure series. This difference does not alter the usefulness or behavior of the soils.

Lamoure soils are similar to the LaDelle soils and are near the LaDelle, Rauville, and Ryan soils. LaDelle soils are moderately well drained. Rauville soils are very poorly drained. Ryan soils have a natric horizon.

Typical pedon from an area of Lamoure silt loam, 2,600 feet west and 935 feet south of the northwest corner of sec. 16, T. 151 N., R. 70 W.

A11—0 to 5 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; slightly hard, friable, slightly sticky, and slightly plastic; slight effervescence; mildly alkaline; abrupt wavy boundary.

A12—5 to 12 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to moderate fine granular; hard, friable, slightly sticky, and plastic; slight effervescence; mildly alkaline; clear wavy boundary.

B21g—12 to 20 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium prismatic structure parting to weak fine subangular blocky; hard, friable, slightly sticky, and plastic; slight effervescence; mildly alkaline; clear irregular boundary.

B22g—20 to 26 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak medium prismatic structure parting to weak fine subangular blocky; hard, friable, slightly sticky, and plastic; slight effervescence; mildly alkaline; diffuse irregular boundary.

Clg—26 to 40 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; massive; hard, firm, sticky, and plastic; slight effervescence; mildly alkaline; diffuse irregular boundary.

C2g—40 to 60 inches; olive gray (5Y 4/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; massive; hard, firm, sticky, and plastic; slight effervescence; mildly alkaline.

The thickness of the solum is 24 to 36 inches. Depth to carbonates is 0 to 10 inches. Thickness of the mollic epipedon is 24 to 40 inches. A buried A horizon is in some pedons below a depth of 30 inches.

The A horizon has hue of 10YR, 2.5Y, or 5Y; value of 2 or 3 (3 or 4 dry), and chroma of 1 or less. It is 12 to 20 inches thick.

The B2 horizon has hue of 10YR, 2.5Y, or 5Y; value of 2 or 3 (3 through 5 dry); and chroma of 1 or less. It is mainly silty clay loam, but the range includes silt loam and is 12 to 16 inches thick.

The Cg horizon has hue of 2.5Y or 5Y, value of 3 or 4 (5 or 6 dry), and chroma of 1 or 2. Some pedons contain strata of sand, gravel, or clay loam.

Larson series

The Larson series consists of deep, moderately well drained and somewhat poorly drained, slowly permeable, sodic soils on glacial till plains. These soils formed in loamy glacial till. Slope is 1 to 3 percent.

Larson soils are similar to the Cathay and Miranda soils and are near the Cathay, Emrick, Fram, Heimdal, and Miranda soils. Cathay soils have tonguing or interfingering of albic materials into the B21t horizon. Emrick and Heimdal soils do not have a natric horizon. Fram soils do not have a natric horizon and have a calcic horizon within a depth of 16 inches. Miranda soils have visible salt crystals within a depth of 16 inches.

Typical pedon of Larson loam, from an area of Larson-Cathay loams, 1 to 3 percent slopes, 2,600 feet west and 145 feet south of the northeast corner of sec. 29, T. 153 N., R. 69 W.

A1—0 to 6 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky, and slightly plastic; many roots; neutral; abrupt smooth boundary.

A2—6 to 7 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate medium subangular blocky structure parting to moderate thin platy; slightly hard, friable, slightly sticky, and slightly plastic; many roots; neutral; abrupt wavy boundary.

B21t—7 to 11 inches; very dark brown (10YR 2/2) clay loam, dark grayish brown (10YR 4/2) dry; strong coarse and medium columnar structure parting to strong medium and fine subangular; hard, firm, sticky, and plastic; thin very dark gray (10YR 3/1) coatings on tops of columns; moderately alkaline; gradual wavy boundary.

B22t—11 to 16 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; strong medium prismatic structure parting to strong medium and fine angular blocky; hard, firm, sticky, and plastic; mildly alkaline; clear wavy boundary.

B3ca—16 to 20 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to moderate medium and fine subangular blocky; hard, fri-

able, sticky, and plastic; slight effervescence; strongly alkaline; abrupt smooth boundary.

C1ca—20 to 26 inches; light brownish gray (2.5Y 6/2) clay loam, light gray (2.5Y 7/2) dry; weak medium prismatic structure parting to moderate medium angular blocky; hard, firm, sticky, and plastic; about 10 percent pebbles and coarse fragments; violent effervescence; strongly alkaline; gradual wavy boundary.

C2ca—26 to 33 inches; grayish brown (2.5Y 5/2) clay loam, light gray (2.5Y 7/2) dry; weak medium prismatic structure parting to moderate medium angular blocky in the upper part and massive in the lower part; hard, firm, sticky, and plastic; violent effervescence; strongly alkaline.

C3—33 to 60 inches; light olive brown (2.5Y 5/4) clay loam, light brownish gray (2.5Y 6/2) dry; massive; hard, firm, sticky, and plastic; strong effervescence; strongly alkaline.

The thickness of the solum is 14 to 24 inches. The A1 horizon has hue of 10YR, value of 2 or 3 (3 through 5 dry), and chroma of 1. The A2 horizon has hue of 10YR, value of 2 through 5 (5 through 7 dry), and chroma of 1. It is loam or silt loam. In many profiles, the A1 and A2 horizons are mixed in cultivation.

The B2 horizon has hue of 10YR or 2.5Y, value of 2 through 4 (4 through 6 dry), and chroma of 2 through 3. It is loam or clay loam. Some profiles do not have a B3ca horizon.

The C horizon has hue of 2.5Y or 5Y, value of 4 through 6 (5 through 7 dry), and chroma of 2 through 4. It is moderately alkaline or strongly alkaline and contains 5 to 10 percent rock fragments by volume.

Letcher series

The Letcher series consists of deep, moderately well drained, sodic soils on outwash plains. Permeability in these soils is slow in the subsoil and moderately rapid in the underlying material. These soils formed in sandy glacial outwash and eolian material. Slope is 1 to 3 percent.

Letcher soils are near the Egeland, Embden, Hecla, and Stirum soils. Egeland, Embden, and Hecla soils have no natric horizon. Stirum soils are poorly drained and have a strongly calcareous B horizon.

Typical pedon of Letcher fine sandy loam, from an area of Embden-Letcher fine sandy loams, 1 to 3 percent slopes, 1,900 feet south and 860 feet west of the northeast corner of sec. 30, T. 154 N., R. 71 W.

Ap—0 to 9 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak very fine granular structure; soft, very friable, slightly sticky, and slightly plastic; mildly alkaline; abrupt wavy boundary.

A2—9 to 10 inches; dark grayish brown (10YR 4/2) loamy fine sand, grayish brown (10YR 5/2) dry; weak very fine platy structure; slightly hard, very friable, nonsticky, and nonplastic; mildly alkaline; clear wavy boundary.

B2t—10 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, brown (10YR 5/3) dry; strong coarse columnar structure parting to strong medium and fine subangular; hard, very friable, slightly sticky, and slightly plastic; common thin clay films on faces of peds; very thin very dark gray (10YR 3/1) coatings on tops of columns; slight effervescence; strongly alkaline; clear wavy boundary.

B3ca—16 to 23 inches; brown (10YR 4/3) fine sandy loam, brown (10YR 5/3) dry; moderate coarse prismatic structure parting to moderate medium and fine subangular; hard, very friable, slightly sticky, and plastic; common thin clay films on faces of peds; many fine distinct segregations of lime; strong effervescence; strongly alkaline; clear wavy boundary.

C1ca—23 to 34 inches; light olive brown (2.5Y 5/4) fine sandy loam, light yellowish brown (2.5Y 6/4) dry; many coarse distinct mottles of light olive gray (5Y 6/2); weak coarse prismatic structure; hard, friable, slightly sticky, and slightly plastic; strong effervescence; strongly alkaline; gradual wavy boundary.

C2—34 to 39 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; common fine distinct yellowish brown (10YR 5/6) and many coarse distinct light olive (5Y 6/2) mottles; weak coarse prismatic structure; hard, friable, slightly sticky, and slightly plastic; strong effervescence; strongly alkaline; gradual wavy boundary.

IIc—39 to 60 inches; light olive brown (2.5Y 5.4) sand; light yellowish brown (2.5Y 6/4) dry; many fine distinct yellowish brown (10YR 5/6) and light olive gray (5Y 6/2) mottles; single grain loose, nonsticky, and nonplastic; slight effervescence; strongly alkaline.

The thickness of the solum is 15 to 36 inches. Depth to carbonates is 10 to 25 inches.

The Ap horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1. It is fine sandy loam or sandy loam and is 6 to 14 inches thick. The A2 horizon has hue of 10YR or 2.5Y, value of 3 or 4 (5 through 7 dry), and chroma of 1 or 2. It is fine sandy loam, loamy fine sand, or sandy loam, and is 1 inch to 2 inches thick. There is no A2 horizon in some profiles, and in other profiles, the Ap and A2 horizons are mixed in cultivation.

The B2t horizon has hue of 10YR or 2.5Y, value of 3 or 4 (4 or 5 dry), and chroma of 2 or 3 moist or dry. It is fine sandy loam or sandy loam.

The C horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 or 5 (5 or 6 dry); and chroma of 1 through 4 moist or dry. It is loam, fine sandy loam, or loamy fine sand; but sand is within the range for the lower part of the C horizon. Some pedons have a buried A horizon.

Maddock series

The Maddock series consists of deep, well drained, rapidly permeable soils on sandy uplands. These soils formed in eolian and outwash sands. Slope is 1 to 15 percent.

Maddock soils are similar to the Hecla soils and are near the Dickey, Egeland, Embden, Hecla, and Towner soils. Dickey and Towner soils have loam or clay loam in the lower part of their C horizon. Egeland and Embden soils have a loam or fine sandy loam control section. Hecla soils have a thicker mollic epipedon and are moderately well drained.

Typical pedon of Maddock loamy fine sand, from an area of Maddock-Hecla loamy fine sands, 3 to 6 percent slopes, 1,130 feet south and 150 feet west of the northeast corner of sec. 7, T. 156 N., R. 71 W.

A1—0 to 12 inches; very dark gray (10YR 3/1) loamy fine sand, dark gray (10YR 4/1) dry; single grain; loose, nonsticky, and nonplastic; neutral; clear smooth boundary.

B2—12 to 21 inches; dark brown (10YR 3/3) loamy fine sand, brown (10YR 5/3) dry; weak coarse prismatic structure; loose, nonsticky, and nonplastic; neutral; clear smooth boundary.

C1—21 to 50 inches; dark brown (10YR 4/3) fine sand, brown (10YR 5/3) dry; single grain; loose, nonsticky, and nonplastic; neutral; gradual boundary.

C2—50 to 60 inches; dark grayish brown (2.5Y 4/2) fine sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky, and nonplastic; neutral; slight effervescence.

The thickness of the solum is 10 to 30 inches. Thickness of the mollic epipedon is 10 to 16 inches. Some profiles contain a few pebbles and coarse fragments.

The A horizon has hue of 10YR, value of 2 or 3 (3 through 5 dry), and chroma of 1. It is mainly loamy fine sand, but the range includes loamy sand, fine sandy loam, and sandy loam.

The B2 horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 2 or 3. It is typically loamy fine sand, but the range includes fine sand and loamy sand.

The C horizon has hue of 10YR or 2.5Y, value of 3 or 4 (4 through 6 dry), and chroma of 2 through 4.

Marysland series

The Marysland series consists of deep, poorly drained and very poorly drained soils in outwash basins and drainageways. These soils are moderately permeable in the upper part and are rapidly permeable in the underlying material. These soils are moderately deep over sand and gravel. They formed in loamy alluvium over sand and gravel. Slope is 0 to 1 percent.

Marysland soils are similar to the Divide soils and are near the Arvilla, Borup, Divide, Fordville, and Renshaw soils in the landscape. Arvilla, Fordville, and Renshaw soils have a B horizon and are better drained. Borup soils have a coarse-silty texture in the solum and do not have sand and gravel at a depth of 20 to 40 inches. Divide soils are better drained and do not have distinct mottles within a depth of 16 inches.

Typical pedon from an area of Marysland loam, 1,320 feet south and 1,055 feet east of the northwest corner of sec. 17, T. 151 N., R. 67 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine and very fine granular structure; slightly hard, friable, slightly sticky, and slightly plastic; strong effervescence; mildly alkaline; abrupt irregular boundary.

C1ca—8 to 17 inches; dark gray (5Y 4/1) light clay loam, gray (5Y 6/1) dry; common fine faint gray (5Y 5/1) and few fine distinct brown (10YR 4/3) mottles; very coarse and coarse subangular blocky structure parting to weak very fine and fine granular; hard, friable, sticky, and plastic; violent effervescence; mildly alkaline; clear wavy boundary.

C2ca—17 to 26 inches; olive gray (5Y 5/2) loam, light gray (5Y 7/2) dry; many coarse prominent dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; slightly hard, friable, sticky, and plastic; violent effervescence; mildly alkaline; clear wavy boundary.

IIC3g—26 to 60 inches; dark grayish brown (10YR 4/2) coarse sand, light brownish gray (10YR 6/2) dry; few coarse distinct dark brown (7.5YR 4/4) mottles; few fine prominent yellowish red (5YR 4/6) mottles; many fine medium faint dark gray (10YR 4/1) mottles, and few fine faint very dark gray (10YR 3/1) mottles; single grain; loose, nonsticky, and nonplastic; about 10 percent gravel; slight effervescence; mildly alkaline.

The depth to the IIC horizon is 20 to 40 inches. The thickness of the mollic epipedon is 7 to 20 inches.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (4 or 5 dry), and chroma of 1; or it is N 2/0 or N 3/0 (N 4/0 or N 5/0 dry).

The Cca horizon has hue of 2.5Y or 5Y, value of 4 or 5 (5 through 7 dry), and chroma of 1 or 2. It is clay loam, sandy clay loam, or loam. The IIC horizon is coarse sand or stratified sand and gravel. In some pedons a buried A horizon is above the IIC horizon.

Minnewaukan series

The Minnewaukan series consists of deep, poorly drained, rapidly permeable soils in lake basins. These soils formed in calcareous sands. Slope is 1 to 3 percent.

Minnewaukan soils are near the Lallie soils. Lallie soils are fine textured throughout.

Typical pedon from an area of Minnewaukan loamy fine sand, 1 to 3 percent slopes, 1,025 feet south and 1,050 feet east of the northwest corner of sec. 14, T. 153 N., R. 66 W.

- A1—0 to 2 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; weak fine granular structure; loose, nonsticky, and nonplastic; mildly alkaline; abrupt smooth boundary.
- AC—2 to 5 inches; very dark grayish brown (2.5Y 3/2) loamy fine sand, grayish brown (2.5Y 5/2) dry; single grain; loose, nonsticky, and nonplastic; neutral; abrupt smooth boundary.
- C1g—5 to 19 inches; olive gray (5Y 4/2) fine sand, light olive gray (5Y 6/2) dry; common fine prominent dark yellowish brown (10YR 3/6) mottles; single grain; loose, nonsticky, and nonplastic; strong effervescence; moderately alkaline; clear wavy boundary.
- C2g—19 to 33 inches; dark grayish brown (2.5Y 4/2) and grayish brown (2.5Y 5/2) fine sand, grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) dry; common fine prominent dark yellowish brown (10YR 3/6) mottles; single grain; slightly hard, loose, nonsticky, and nonplastic; strong effervescence; moderately alkaline; clear wavy boundary.
- C3g—33 to 45 inches; olive gray (5Y 5/2) fine sand, light gray (5Y 7/2) moist; few medium prominent yellowish brown (10YR 5/6) mottles; single grain; slightly hard, loose, nonsticky, and nonplastic; strong effervescence; moderately alkaline; clear wavy boundary.
- C4g—45 to 60 inches; olive gray (5Y 5/2) fine sand, light olive gray (5Y 6/2) dry; few fine prominent dark yellowish brown (10YR 3/4) mottles; single grain; slightly hard, loose, nonsticky, and nonplastic; strong effervescence; moderately alkaline.

The 10- to 40-inch control section is typically fine sand, but ranges to loamy sand, loamy fine sand, or sand. Some pedons contain up to 20 percent gravel by volume. Some pedons are saline.

The A1 and AC horizons have hue of 10YR through 5Y, value of 2 through 4 (3 through 6 dry), and chroma of 1 or 2.

The C horizon has hue of 2.5Y or 5Y, value of 3 through 5 (4 through 7 dry), and chroma of 1 through 4.

Miranda series

The Miranda soils consist of deep, moderately well drained or somewhat poorly drained, very slowly permeable sodic soils on glacial till plains. These soils formed in loamy calcareous glacial till. Slope is 1 to 6 percent.

Miranda soils are similar to the Cathay, Cavour, Cresbard, and Larson soils and are near the Cathay, Cavour,

Cresbard, Larson, and Vallers soils. Cathay, Cavour, Cresbard, and Larson soils have a thicker A horizon and do not have high accumulations of salts near the surface. Vallers soils have no natric horizon.

Typical pedon of Miranda loam, from an area of Cavour-Miranda complex, 1 to 6 percent slopes, 1,450 feet west and 140 feet north of the southeast corner of sec. 36, T. 154 N., R. 71 W.

- A1—0 to 3 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak very fine granular; soft, very friable, slightly sticky, and plastic; many roots; neutral; abrupt smooth boundary.
- A2—3 to 5 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate medium platy structure parting to weak fine subangular blocky; soft, very friable, slightly sticky, and slightly plastic; many roots; neutral; abrupt boundary.
- B21t—5 to 9 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; moderate medium and coarse columnar structure parting to moderate medium subangular blocky; hard, firm, sticky, and plastic; few roots on tops of columns; very dark gray (10YR 5/1) dry uncoated very fine sand grains on tops of columns; mildly alkaline; clear smooth boundary.
- B22t—9 to 14 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate medium and coarse prismatic structure parting to strong medium and coarse angular blocky; very hard, firm, sticky, and plastic; common medium nests and common fine threads of salt; moderately alkaline; clear smooth boundary.
- B23tsa—14 to 19 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; very hard, firm, sticky, and plastic; few medium and large nests and common fine threads of salt; moderately alkaline; abrupt irregular boundary.
- B3sa—19 to 22 inches; very dark grayish brown (2.5Y 3/2) heavy clay loam, dark grayish brown (2.5Y 4/2) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; hard, friable, sticky, and very plastic; common medium and large nests of salts; fine irregularly shaped soft masses of segregated lime; slight effervescence; strongly alkaline; gradual wavy boundary.
- C1casa—22 to 46 inches; dark grayish brown (2.5Y 4/2) clay loam, light yellowish brown (2.5Y 6/4) dry; many large distinct light brownish gray (2.5Y 6/2) mottles; massive; hard, friable, sticky, and plastic; common medium and large nests of salt; strong effervescence; strongly alkaline; gradual wavy boundary.

C2cs—46 to 60 inches; olive brown (2.5Y 4/4) clay loam, light olive brown (2.5Y 5/4) dry; many large prominent dark gray (N 4/0) and common medium prominent yellowish red (5YR 4/6) mottles; massive; very hard, friable, sticky, and plastic; few fine nests of salt and fine gypsum crystals; slight effervescence; strongly alkaline.

The thickness of the solum is 10 to 22 inches. Depth to carbonates is 10 to 25 inches. The depth to gypsum and salt accumulations is 6 to 16 inches. Some pedons contain 2 to 10 percent pebbles.

The A1 horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1. It is 1 inch to 3 inches thick. The A2 horizon has hue of 10YR, value of 3 or 4 (5 or 6 dry), and chroma of 1. Typically, it is loam, but the range includes silt loam. The A2 horizon is 2 to 5 inches thick. In cultivated areas, the A horizon and upper part of the B horizon are mixed.

The B2t horizon has hue of 10YR, value of 2 or 3 (4 or 5 dry), and chroma of 1 or 2. It is 4 to 14 inches thick.

The C horizon has hue of 2.5Y or 5Y, value of 4 or 5 (5 through 7 dry), and chroma of 2 through 4. It is clay loam or loam. Mottles range from few to many.

Miranda variant

The Miranda variant soils consist of deep, moderately well drained or somewhat poorly drained, very slowly permeable sodic soils on side slopes and foot slopes below breaks. These soils formed in calcareous glacial till over noncalcareous weathered shale. Slope is 3 to 15 percent.

Miranda variant soils are similar to the Cavour, Darnen, Cresbard, Miranda, and Ryan soils and are near the Cavour, Cresbard, Darnen, Esmond, Lamoure, and Ryan soils. Cavour and Cresbard soils formed in glacial till, have a thicker A horizon, and do not have accumulations of salts near the surface. Miranda soils formed in glacial till and have a lower clay content. Ryan soils are poorly drained and are on stream terraces and bottom lands. Miranda variant soils are on steeper slopes. Esmond and Darnen soils have no natric horizon. Lamoure soils have no natric horizon and are on level stream bottom lands.

Typical pedon from an area of Miranda Variant loam, 3 to 15 percent slopes, 1,110 feet south and 65 feet west of the northeast corner of sec. 36, T. 151 N., R. 66 W.

A2—0 to 1 inch; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine play structure parting to weak fine granular; soft, very friable, slightly sticky, and plastic; many roots; mildly alkaline; abrupt smooth boundary.

B2t—1 to 8 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium columnar structure parting to strong medium and fine angular

blocky; very hard, firm, sticky, and plastic; common roots on tops of columns; very dark gray (10YR 5/1) dry silt coatings on tops of columns; moderately alkaline; clear wavy boundary.

B3ca—8 to 13 inches; very dark grayish brown (2.5Y 3/2) silty clay, grayish brown (2.5Y 5/2) dry; moderate, medium prismatic structure parting to strong medium and fine angular blocky; very hard, firm, sticky, and plastic; few roots, strong effervescence; moderately alkaline; clear smooth boundary.

C1casa—13 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; common fine and medium faint light gray (2.5Y 7/2) dry mottles; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, firm, sticky, and plastic; common medium nests of salt; medium irregularly shaped soft masses of segregated lime; violent effervescence; strongly alkaline; gradual wavy boundary.

C2cssa—24 to 36 inches; olive gray (5Y 4/2) silty clay; olive gray (5Y 5/2) dry; few fine, prominent reddish brown (5YR 5/4) dry mottles; massive, very hard, friable, sticky, and plastic; common medium nests of salt and gypsum; strongly alkaline; gradual wavy boundary.

C3cs—36 to 42 inches; olive gray (5Y 4/2) silty clay; olive gray (5Y 5/2) dry; common fine distinct reddish brown (5YR 5/4) dry mottles; massive; very hard, friable, sticky, and plastic; common medium nests of salt and gypsum; strongly alkaline; about 10 percent fine soft shale fragments, gradual wavy boundary.

llcr—42 to 60 inches; weathered shale bedrock.

The thickness of the solum is 10 to 18 inches. Depth to carbonates is 8 to 15 inches. The depth to gypsum and salt accumulations is 8 to 13 inches.

The A2 horizon has hue of 10YR, value of 2 through 4 (3 through 5 dry), and chroma of 1. It is 1 inch to 2 inches thick. The B2t horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 through 5 dry), and chroma of 1 or 2. It is 6 to 14 inches thick. Typically, it is silty clay, but the range includes silty clay loam and clay loam.

In some pedons, the lower parts of the B2t horizon and the B3ca horizon contain few or common gypsum crystals and other salts. Some profiles have no B3ca horizon.

The C horizon has hue of 2.5Y or 5Y and value of 3 through 5 (4 through 7 dry).

Overly series

The Overly series consists of deep, moderately well drained soils on glacial lake plains. Permeability of these soils is moderately slow. These soils formed in silty, calcareous glacial lacustrine sediment. Slope is 1 to 3 percent.

Overly soils are similar to the Gardena and Great Bend soils and are near the Bearden, Colvin, and Great Bend soils. Gardena soils have a coarse-silty control section. Great Bend soils have a mollic epipedon less than 16 inches thick. Bearden and Colvin soils are somewhat poorly drained and poorly drained, respectively. In addition, they have a calcic horizon within a depth of 16 inches.

Typical pedon from an area of Overly silty clay loam, 1 to 3 percent slopes, 1,925 feet south and 850 feet east of the northwest corner of sec. 23, T. 153 N., R. 66 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; slightly hard, friable, slightly sticky, and slightly plastic; mildly alkaline; abrupt smooth boundary.

A12—7 to 10 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; mildly alkaline; clear wavy boundary.

B21—10 to 18 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to moderate fine and medium angular blocky; hard, firm, sticky, and plastic; mildly alkaline; clear wavy boundary.

B22—18 to 25 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate fine and medium angular blocky; hard, firm, sticky, and plastic; slight effervescence lime in few fine rounded segregated soft masses; moderately alkaline; clear wavy boundary.

B3ca—25 to 27 inches; very dark grayish brown (2.5Y 3/2) silty clay loam, grayish brown (2.5Y 5/2) dry; weak medium prismatic structure parting to moderate medium angular blocky; hard, firm, sticky, and plastic; slight effervescence; strongly effervescent lime in many medium segregated soft masses; moderately alkaline; clear wavy boundary.

C1ca—27 to 42 inches; light brownish gray (2.5Y 6/2) silty clay loam, light gray (2.5Y 7/2) dry; massive; hard, firm, sticky, and plastic; violent effervescence; moderately alkaline; clear wavy boundary.

C2—42 to 60 inches; olive (5Y 5/3) silty clay loam, pale yellow (5Y 7/3) dry; few fine faint olive (5Y 5/4) mottles; massive and laminated; hard, firm, sticky, and plastic; strong effervescence; strongly effervescent lime in common medium irregularly shaped segregated soft masses and threads; moderately alkaline.

The thickness of the solum is 16 to 36 inches. The mollic epipedon is 16 to 30 inches thick.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. It is 8 to 18 inches thick.

The B2 horizon has hue of 10YR or 2.5Y, value of 2 to 4 (3 to 5 dry), and chroma of 1 or 2.

The Cca horizon has hue of 2.5Y, value of 4 through 6 (6 or 7 dry), and chroma of 2 through 4. The lime is disseminated or segregated in soft masses. The C horizon has hue of 2.5Y or 5Y, value of 4 through 6 (6 or 7 dry), and chroma of 1 through 4. Mottles range from few to many and are faint to prominent. Typically, the C horizon is silty clay loam, but clay loam is below a depth of 40 inches in some pedons.

Parnell series

The Parnell series consists of deep, very poorly drained, slowly permeable soils in deep closed depressions in glacial till plains. These soils formed in loamy or silty local alluvium. Slope is 0 to 1 percent.

Parnell soils are similar to the Tonka soils, and are near the Tonka and Vallers soils. Tonka soils have an albic horizon more than 4 inches thick. Vallers soils are poorly drained and have a high accumulation of free carbonates within a depth of 16 inches.

Typical pedon from an area of Parnell silty clay loam, 2,065 feet east and 75 feet south of the northwest corner of sec. 24, T. 156 N., R. 69 W.

O1—1 inch to 0; partially decomposed organic matter.

A1—0 to 14 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky and granular structure; hard, friable, sticky, and plastic; slightly acid, clear smooth boundary.

B2tg—14 to 36 inches; black (5Y 2/1) silty clay, very dark gray (5Y 3/1) dry; moderate coarse subangular blocky structure parting to strong very fine subangular blocky; very hard, firm, very sticky, and very plastic; few thin clay films on vertical faces of peds; neutral; gradual irregular boundary.

C1g—36 to 46 inches; dark gray (5Y 4/1) silty clay loam, gray (5Y 5/1) dry; many fine distinct olive (5Y 4/3) mottles; massive; very hard, firm, sticky, and plastic; mildly alkaline; clear irregular boundary.

C2g—46 to 60 inches; olive gray (5Y 5/2) silty clay loam, light olive gray (5Y 6/2) dry; many large prominent yellowish brown (10YR 5/6) mottles; massive; very hard, firm, sticky, and plastic; common fine concretions of segregated lime; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to carbonates is 35 to 60 inches. Thickness of the mollic epipedon is 24 to 50 inches.

The O horizon is 0 to 4 inches thick. The A1 horizon has hue of 10YR, value of 2 (3 dry), and chroma of 1, or is N 2/0 (N 3/0 dry). It is 10 to 25 inches thick and has faint mottles in some pedons. Reaction is neutral or

slightly acid. Some pedons have an A2 horizon as much as 4 inches thick.

The B2t horizon has hue of 2.5Y or 5Y, value of 2 through 4 (3 through 5 dry), and chroma of 1 or 2. It is typically silty clay, but the range includes silty clay loam and clay loam. It is 14 to 36 inches thick and has faint to prominent mottles in some pedons. Reaction is slightly acid to mildly alkaline.

The C horizon has hue of 5Y, value of 4 or 5 (5 or 6 dry), and chroma of 1 or 2. It is typically silty clay loam, but the range includes loam and clay loam. Mottles are faint to prominent. Reaction is neutral or mildly alkaline.

Rauville series

The Rauville series consists of deep, very poorly drained soils on stream bottom lands and in drainageways on glacial till plains. Permeability of these soils is moderately slow. These soils formed in calcareous silty alluvium. Slope is 0 to 1 percent.

Rauville soils are similar to the Lamoure soils, and are near the Lamoure, Colvin, and LaDelle soils. Lamoure soils are poorly drained. LaDelle soils are moderately well drained and are not calcareous to the surface. Colvin soils have a calcic horizon within a depth of 16 inches.

Typical pedon from an area of Rauville silt loam, 1,240 feet north and 720 feet east of the southwest corner of sec. 9, T. 151 N., R. 65 W.

A11—0 to 8 inches; black (10YR 2/1) silt loam, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, friable, slightly sticky, and slightly plastic; strong effervescence; mildly alkaline; gradual wavy boundary.

A12—8 to 20 inches; black (10YR 2/1) silt loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, and slightly plastic; strong effervescence; mildly alkaline; gradual wavy boundary.

A13g—20 to 29 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few fine distinct brown (10YR 4/3) mottles; weak medium subangular blocky structure parting to moderate fine granular; hard, firm sticky, and plastic; strong effervescence; mildly alkaline; gradual wavy boundary.

C1g—29 to 42 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; very hard, very firm, sticky and plastic; slight effervescence; mildly alkaline; clear wavy boundary.

C2g—42 to 60 inches; olive gray (5Y 5/2) silty clay loam, light gray (5Y 7/2); dry; many fine distinct light olive brown (2.5Y 5/4) mottles; massive; very hard, very

firm, sticky, and plastic; slight effervescence; mildly alkaline.

The thickness of the mollic epipedon is 24 to 35 inches. The profile averages 25 to 35 percent clay. Some pedons have a buried A horizon, and other pedons have an O horizon as much as 6 inches thick.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 through 5 dry), and chroma of 1 or 2.

The Cg horizon has hue of 10YR, 2.5Y, or 5Y; value of 3 through 5 (5 through 7 dry); and chroma of 1 or 2. Some pedons have a IIC horizon of stratified sand or gravel below a depth of 40 inches.

Renshaw series

The Renshaw series consists of deep, somewhat excessively drained, rapidly permeable soils on stream terraces and outwash plains. These soils are shallow over sand and gravel. They formed in a thin mantle of loamy alluvium over sand and gravel. Slope is 1 to 6 percent.

Renshaw soils are similar to the Brantford, Fordville, and Sioux soils, and are near the Divide, Fordville, Marysland, and Sioux soils. Brantford soils have shaly sand and gravel in the IIC horizon. Fordville soils have a thicker solum, and the IIC horizon is at a depth of 20 to 40 inches. Sioux soils do not have a B horizon. The somewhat poorly drained Divide soils and the poorly drained and very poorly drained Marysland soils have a calcic horizon.

Typical pedon from an area of Renshaw loam, 1 to 3 percent slopes, 2,000 feet south and 90 feet east of the northwest corner of sec. 9 T. 151 N., R. 70 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine granular structure; slightly hard, very friable, slightly sticky, and plastic; about 5 percent gravel; neutral; abrupt smooth boundary.

B21—7 to 12 inches; very dark grayish brown (10YR 3/2) loam, dark brown (10YR 4/3) dry; moderate medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky, and plastic; about 5 percent gravel; neutral; clear smooth boundary.

B22—12 to 16 inches; dark brown (10YR 4/3) loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky, and plastic; about 5 percent gravel; neutral; clear smooth boundary.

IIC1ca—16 to 38 inches; dark brown (10YR 4/3), dark gray (10YR 4/1) and light gray (10YR 7/2) coarse sand and gravel, brown (10YR 5/3), gray (10YR 5/1), and white (10YR 8/2) dry; single grain; loose, nonsticky, and nonplastic; about 25 percent gravel; lime crusts on pebbles; strong effervescence; neutral; gradual wavy boundary.

IIC2—38 to 60 inches; dark brown (10YR 4/3), dark gray (10YR 4/1), and brown (7.5YR 5/4) coarse sand and gravel, brown (10YR 5/3), gray (10YR 5/1), and light brown (7.5YR 6/4) dry; single grain; loose, non-sticky, and nonplastic; about 35 percent gravel; slight effervescence; neutral.

The thickness of the solum, the depth to carbonates, and the depth to sand and gravel is 14 to 20 inches. Thickness of the mollic epipedon is 10 to 16 inches and includes all or most of the B horizon.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. Thickness is 5 to 8 inches.

The B2 horizon has hue of 10YR, value of 3 or 4 (4 or 5 dry), and chroma of 2 or 3. It is 6 to 12 inches thick. Typically, the B2 horizon is loam, but the range includes light clay loam.

The IIC horizon has hue of 10YR and 7.5YR. It is gravel, coarse sand, sand and gravel, or stratified sand and gravel. Reaction is neutral or mildly alkaline.

Ryan series

The Ryan series consists of deep, poorly drained, very slowly permeable, sodic soils on stream bottom lands, low terraces, and in glacial lake plains. These soils formed in clayey lacustrine and alluvial sediment. Slope is 0 to 1 percent.

Ryan soils are near the LaDelle and Lamoure soils. These soils contain less clay and have no natric horizon.

Typical pedon from an area of Ryan silty clay, 2,010 feet north and 25 feet east of the southwest corner of sec. 18, T. 151 N., R. 68 W.

A1—0 to 3 inches; black (10YR 2/1) silty clay, gray (10YR 5/1) and dark gray (10YR 4/1) dry; weak fine granular structure; hard, friable, slightly sticky, and slightly plastic; slightly acid; abrupt smooth boundary.

B21t—3 to 10 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; strong medium prismatic structure parting to strong fine and medium subangular; extremely hard, very firm, very sticky, and very plastic; moderately alkaline; clear smooth boundary.

B22t—10 to 16 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; strong medium prismatic structure parting to strong fine and medium subangular blocky; extremely hard, very firm, very sticky, and very plastic; few small masses of salts; slight effervescence; moderately alkaline; clear wavy boundary.

C1cs—16 to 21 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate fine prismatic; very hard, firm, very sticky, and very plastic; many fine threads and crystals of calcium sulfate; slight ef-

fervescence; moderately alkaline; gradual wavy boundary.

C2—21 to 36 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; weak coarse prismatic structure; very hard, firm, very sticky, and very plastic; few fine crystals and nests of calcium sulfate; strong effervescence; strongly alkaline; gradual wavy boundary.

C3—36 to 60 inches; olive gray (5Y 4/2) silty clay, light olive gray (5Y 6/2) dry; common fine distinct light olive brown (2.5Y 5/4) mottles; massive; very hard, firm, very sticky, and very plastic; strong effervescence; strongly alkaline.

The thickness of the solum is 9 to 16 inches. The mollic epipedon is 20 to 50 inches thick.

The A1 horizon has hue of 10YR through 5Y, value of 2 or 3 (3 through 5 dry), and chroma of 1; or it is N 2/0 or N 3/0 (N 3/0 through N 5/0 dry). It is 1 to 4 inches thick. In some pedons an A2 horizon is 1 to 2 inches thick. In cultivated areas there is an Ap horizon consisting of the A horizon and the upper part of the B2t horizon.

The B2t horizon has hue of 10YR through 5Y, value of 2 or 3 (3 or 4 dry), and chroma of 1; or it is N 2/0 or N 3/0 (N 3/0 or N 4/0 dry). It is clay or silty clay and is 6 to 14 inches thick. Reaction is neutral to moderately alkaline.

The C horizon has hue of 10YR, 2.5Y, or 5Y; value of 2 through 4 (4 through 6 dry); and chroma of 1 or 2. It is typically silty clay, but the range includes clay or silty clay loam.

Sioux series

The Sioux series consists of deep, excessively drained, rapidly permeable soils on stream terraces, outwash plains, eskers, and glacial moraines. These soils are shallow over sand and gravel. They formed in loamy material over sand and gravel outwash. Slope is 1 to 25 percent.

Sioux soils are similar to the Coe and Renshaw soils and are near the Arvilla, Barnes, Buse, Fordville, and Renshaw soils. Coe soils have a shaly C horizon. Arvilla, Fordville, and Renshaw soils have a B horizon and are more than 14 inches deep to sand and gravel. Barnes and Buse soils have more clay throughout the profile and formed in loamy glacial till.

Typical pedon from an area of Sioux gravelly loam, 9 to 25 percent slopes, 1,700 feet west and 75 feet south of the northeast corner of sec. 32, T. 152 N., R. 71 W.

A1—0 to 5 inches; black (10YR 2/1) gravelly loam, dark gray (10YR 4/1) dry; weak fine and medium granular structure; slightly hard, very friable, slightly sticky, and slightly plastic; slight effervescence; neutral; clear smooth boundary.

AC—5 to 9 inches; very dark grayish brown (10YR 3/2) gravelly loam, dark grayish brown (10YR 4/2) dry; weak fine and medium granular structure; slightly hard, very friable, nonsticky, and slightly plastic; about 30 percent gravel; slight effervescence; mildly alkaline; clear smooth boundary.

C—9 to 60 inches; dark brown and brown (10YR 4/3) and dark yellowish brown (10YR 4/4) very gravelly sand, brown (10YR 5/3) and yellowish brown (10YR 5/4) dry; single grain; loose, nonsticky, and nonplastic; about 50 percent gravel; lime coats the underside of pebbles in the upper part, strong effervescence; moderately alkaline.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. It is typically gravelly loam, but the range includes loam. The horizon is 4 to 8 inches thick. Reaction is neutral or mildly alkaline. The C horizon is gravelly sand and very gravelly sand. It has hue of 10YR, value of 4 through 6 (5 through 7 dry), and chroma of 3 or 4. In the upper part of some pedons, lime does not coat the undersides of the pebbles.

Stirum series

The Stirum series consists of deep, poorly drained sodic soils on glacial outwash and lake plains. Permeability of these soils is moderately slow. These soils formed in moderately coarse or coarse glacial outwash or glacial lacustrine sediment. Slope is 0 to 1 percent.

Stirum soils are similar to the Fossum soils, and are near the Letcher, Fossum, and Hecla soils. Fossum soils have no natric horizon and contain less clay in the 10- to 40-inch control section. Letcher soils are moderately well drained, have no calcium carbonate accumulation in the solum, and have no mottles in the B horizon. Hecla soils are moderately well drained, have no natric horizon, and have no calcium carbonate accumulation in the solum.

Typical pedon from an area of Stirum loamy fine sand, 1,810 feet west and 860 feet north of the southeast corner of sec. 21, T. 156 N., R. 71 W.

A1—0 to 8 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; weak fine granular; soft, very friable, nonsticky, and nonplastic; moderately alkaline; abrupt smooth boundary.

A2—8 to 9 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; weak medium platy structure; soft, very friable, nonsticky, and nonplastic; moderately alkaline; abrupt wavy boundary.

B21t—9 to 15 inches; very dark gray (5Y 3/1) fine sandy loam, gray (5Y 5/1) dry; moderate medium columnar structure parting to moderate medium subangular blocky; very few thin clay films on faces and lining pores; hard, friable, nonsticky, and nonplastic; strong effervescence; moderately alkaline; abrupt smooth boundary.

B22t—15 to 18 inches; very dark gray (5Y 3/1) fine sandy loam, gray (5Y 5/1) dry; moderate medium subangular blocky structure; very few fine thin clay films on ped faces and lining pores; hard, friable, nonsticky, and nonplastic; strong effervescence; strongly alkaline; abrupt wavy boundary.

C1—18 to 22 inches; olive gray (5Y 4/2) loamy fine sand, light olive gray (5Y 6/2) dry; few fine faint olive brown (2.5Y 4/4) mottles; weak medium subangular blocky structure; slightly hard, friable, nonsticky, and nonplastic; strong effervescence; strongly alkaline; diffuse smooth boundary.

C2—22 to 39 inches; olive (5Y 4/3) loamy fine sand, pale olive (5Y 6/3) dry; few fine yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable, nonsticky, and nonplastic; strong effervescence; strongly alkaline; diffuse smooth boundary.

C3gca—39 to 60 inches; olive gray (5Y 5/2) loamy fine sand, light gray (5Y 7/2) dry; common medium faint olive (5Y 5/4) mottles; massive; slightly hard, friable, nonsticky, and nonplastic; violent effervescence; strongly alkaline.

The thickness of the solum is 16 to 30 inches. The A horizon has hue of 10YR or 2.5Y, value of 2 or 3 (3 to 5 dry), and chroma of 1 or 2. Some pedons have no A2 horizon.

The B2t horizon has hue of 2.5Y or 5Y, value of 3 through 5 (4 through 7 dry), and chroma of 1 or 2. Some pedons have a B3 horizon.

The C horizon is very fine sandy loam, loamy fine sand, or loamy sand. It has hue of 5Y, value of 3 through 5 (5 through 7 dry), and chroma of 2 or 3. Some pedons have texture finer than loamy fine sand below a depth of 40 inches, and some pedons have sand and gravel within a depth of 40 inches.

Svea series

The Svea series consists of deep, moderately well drained soils on glacial till plains. Permeability of these soils is moderately slow. These soils formed in loamy, calcareous glacial till and local alluvium from the till. Slope is 1 to 6 percent.

Svea soils are similar to the Aastad, Barnes, and Emrick soils and are near the Barnes, Buse, and Hamerly soils. Aastad soils contain 28 to 35 percent clay in the solum. Barnes, Buse, and Hamerly soils have a thinner solum. In addition, Buse and Hamerly soils have no B horizon. Emrick soils contain less than 18 percent clay in the 10- to 40-inch control section.

Typical pedon of Svea loam, from an area of Svea-Barnes loams, 1 to 3 percent slopes, 1,880 feet south and 150 feet west of the northeast corner of sec. 35, T. 155 N., R. 68 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly hard, friable, slightly sticky, and plastic; about 1 percent pebbles; slightly acid; abrupt smooth boundary.

A12—8 to 12 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium and coarse prismatic structure parting to weak fine granular; slightly hard, friable, slightly sticky, and plastic; about 1 percent pebbles; neutral; clear wavy boundary.

B21—12 to 18 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium and coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, friable, slightly sticky, and plastic; black (10YR 2/1) coatings on faces of peds; about 5 percent pebbles and coarse fragments; neutral; clear wavy boundary.

B22—18 to 22 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; moderate medium and coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, friable, slightly sticky, and plastic; about 5 percent pebbles and coarse fragments; slight effervescence; neutral; clear wavy boundary.

C1—22 to 28 inches; grayish brown (2.5Y 5/2) loam, light brownish gray (2.5Y 6/2) dry; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, slightly sticky, and plastic; about 5 percent pebbles and coarse fragments; strong effervescence; mildly alkaline; gradual wavy boundary.

C2ca—28 to 38 inches; grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) heavy loam, light gray (2.5Y 7/2) and white (2.5Y 8/2) dry; few fine prominent yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, firm, sticky, and plastic; about 5 percent pebbles and coarse fragments; many medium irregular shaped soft masses of lime; violent effervescence; mildly alkaline; gradual wavy boundary.

C3—38 to 60 inches; grayish brown (2.5Y 5/2) heavy loam, light brownish gray (2.5Y 6/2) dry; common medium faint light brownish gray massive; hard, firm, sticky, and plastic; about 8 percent pebbles and coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum is 16 to 36 inches. The mollic epiedon is 16 to 36 inches thick. It contains 1 to 8 percent pebbles.

The A horizon has hue of 10YR, value of 2 or 3 (3 through 5 dry), and chroma of 1. It is 8 to 20 inches thick.

The B2 horizon has hue of 10YR or 2.5Y, value of 2 through 4 (3 through 5 dry), and chroma of 1 through 3.

Typically, it is loam, but light clay loam is in the range. The B2 horizon is 8 to 16 inches thick. In some pedons, a few mottles are in the lower part of the B2 horizon. Reaction is neutral or mildly alkaline.

The C horizon has hue of 2.5Y, value of 5 or 6 (6 through 8 dry), and chroma of 2 through 4. It is loam, heavy loam, or light clay loam. The upper part of the C horizon contains common segregations of lime. Reaction is mildly alkaline or moderately alkaline.

Tonka series

The Tonka series consists of deep, poorly drained, slowly permeable soils in shallow, closed depressions on glacial till plains. These soils formed in loamy local alluvium. Slope is 0 to 1 percent.

These soils have an abrupt clay increase. This characteristic differs from the defined Tonka series; however, this difference does not alter the usefulness or behavior of the soils.

Tonka soils are similar to the Parnell soils, and near the Hamerly, Parnell, and Vallers soils. Parnell soils have an albic horizon that is 0 to 4 inches thick. Hamerly and Vallers soils have no B horizon but have a calcic horizon.

Typical pedon from an area of Tonka silt loam, 2,180 feet south and 630 feet east of the northwest corner of sec. 8, T. 156 N., R. 68 W.

A1—0 to 14 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure parting to moderate fine granular; slightly hard, very friable, slightly sticky, and nonplastic; neutral; clear wavy boundary.

A2—14 to 22 inches; dark gray (10YR 4/1) silt loam, light gray (10YR 6/1) dry; common medium prominent yellowish brown (10YR 5/4) mottles; moderate thin platy structure parting to weak fine granular; slightly hard, very friable, slightly sticky; and slightly plastic; neutral; clear wavy boundary.

B2t—22 to 38 inches; very dark grayish brown (2.5Y 3/2) silty clay, grayish brown (2.5Y 5/2) dry; common fine faint olive gray (5Y 4/2) mottles; moderate coarse prismatic structure parting to moderate very fine and fine angular blocky; hard, firm, sticky, and plastic; uncoated sand grains on faces of peds in the upper part; slightly acid; gradual wavy boundary.

B3g—38 to 52 inches; olive gray (5Y 4/2) silty clay loam, light olive gray (5Y 6/2) dry; common medium distinct yellowish brown (10YR 5/4) mottles; moderate very fine subangular blocky structure; very hard, firm, sticky, and plastic; slight effervescence; neutral; gradual wavy boundary.

Cg—52 to 60 inches; olive gray (5Y 5/2) silty clay loam, light olive gray (5Y 6/2) dry; many large prominent

yellowish brown (10YR 5/6) mottles; massive; very hard, firm, sticky, and plastic; neutral.

The thickness of the solum and the depth to carbonates is 20 to more than 50 inches. The A1 horizon has hue of 10YR, value of 2 (3 dry), and chroma of 1; or it is N 2/0 (N 3/0 dry). It is silt loam or loam and is 6 to 18 inches thick. The A2 horizon has hue of 10YR or 2.5Y, value of 3 through 4 (5 or 6 dry), and chroma of 1 or 2; or it is N 3/0 or N 4/0 (N 5/0 or N 6/0 dry). It is loam or silt loam and is 4 to 12 inches thick. Mottles are few to many.

The B horizon has hue of 2.5Y or 5Y, value of 3 or 4 (5 or 6 dry), and chroma of 1 or 2. It is clay, silty clay, clay loam, or silty clay loam. The B2t horizon is 8 to 25 inches thick.

The C horizon has hue of 5Y, value of 4 or 5 (6 or 7 dry), and chroma of 1 through 3. It is silty clay loam, clay loam, or loam.

Towner series

The Towner series consists of deep, moderately well drained, soils on fine sandy loam and loamy fine sand mantled glacial till and glacio-lacustrine plains. Permeability of these soils is rapid in the upper part of the profile and moderately slow in the lower part. These soils formed in wind- and water-deposited sandy and loamy material over glacial till or lacustrine sediment. Slope is 1 to 6 percent.

Towner soils are similar to Dickey, Embden, Hecla, and Maddock soils, and are near the Dickey, Egeland, Embden, Hecla, and Maddock soils. Dickey soils have a mollic epipedon less than 16 inches thick. Egeland, Embden, Hecla, and Maddock soils have no horizon at a depth of 20 to 40 inches.

Typical pedon from an area of Towner fine sandy loams, 1 to 6 percent slopes, 1,584 feet south and 120 feet east of the northwest corner of sec. 10, T. 152 N., R. 71 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; soft, very friable, nonsticky, and slightly plastic; about 1 percent pebbles and cobbles on surface; neutral; abrupt smooth boundary.

B2—8 to 18 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak coarse prismatic structure; soft, very friable, nonsticky, and nonplastic; about 1 percent pebbles; neutral; gradual smooth boundary.

C1—18 to 34 inches; brown (10YR 5/3) loamy fine sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky, and nonplastic; about 1 percent coarse fragments; neutral; clear wavy boundary.

IIC2ca—34 to 46 inches; light yellowish brown (2.5Y 6/4) loam, pale brown (2.5Y 7/4) dry; many medium dis-

tinged light brownish gray (2.5Y 6/2) and common medium distinct dark brown (7.5YR 4/4) mottles in the lower part; weak thin platy and weak fine angular blocky structure; hard, very friable, slightly sticky, and plastic; about 1 percent coarse fragments; violent effervescence; mildly alkaline; gradual wavy boundary.

IIC3—46 to 60 inches; light yellowish brown (2.5Y 6/4) loam, pale yellowish (2.5Y 7/4) dry; common medium distinct strong brown (7.5YR 5/6) mottles; hard, friable, sticky, and plastic; about 5 percent pebbles and coarse fragments; strong effervescence; mildly alkaline.

Depth to the IIC horizon and the depth to carbonates is 20 to 40 inches. The mollic epipedon is 16 to 30 inches thick.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. It is 8 to 20 inches thick and is fine sandy loam or loamy fine sand. Some pedons have faint mottles in the lower part of the A horizon.

The C1 horizon has hue of 10YR or 2.5Y, value of 4 or 5 (5 or 6 dry), and chroma of 2 through 4. Typically, it is loamy fine sand, but the range includes loamy sand and fine sand.

Some pedons have faint to distinct mottles in the C1 horizon. The IIC horizon has hue of 2.5Y, value of 5 or 6 (6 through 8 dry), and chroma of 2 through 4. Typically, it is loam but ranges to clay loam, silt loam, or silty clay loam. Some pedons have a pebble contact layer at the top of the IIC horizon.

Vallers series

The Vallers series consists of deep, poorly drained soils on glacial till plains. Permeability of these soils is moderately slow. These soils formed in loamy calcareous glacial till. Slope is 0 to 3 percent.

Vallers soils are similar to the Fram and Hamerly soils, and are near the Fram, Hamerly, Parnell, and Tonka soils. Fram and Hamerly soils are somewhat poorly drained. In addition, Fram soils have less than 18 percent clay in the 10- to 40-inch control section. Parnell and Tonka soils are in lower positions on the landscape and they have no calcic horizon near the surface.

Typical pedon from an area of Vallers loam, 800 feet west and 150 feet north of the southeast corner of sec. 6, T. 156 N., R. 67 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate very fine and fine granular structure; hard, friable, sticky, and plastic; strong effervescence; mildly alkaline; abrupt smooth boundary.

C1gca—9 to 22 inches; gray (5Y 5/1) and olive gray (5Y 5/2) clay loam, light gray (5Y 6/1) and (5Y 7/2) dry; many medium prominent yellowish brown (10YR

5/4) mottles; weak medium subangular blocky structure; hard, firm, sticky, and plastic; about 5 percent pebbles and coarse fragments; violent effervescence; mildly alkaline; clear wavy boundary.

C2gcs—22 to 44 inches; olive gray (5Y 5/2) and gray (5Y 5/1) clay loam, light olive gray (5Y 6/2) and light gray (5Y 7/1) dry; many large prominent yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; hard, firm, sticky, and plastic; about 5 percent pebbles and coarse fragments; many crystals and nests of calcium sulfate; strong effervescence; mildly alkaline; gradual wavy boundary.

C3g—44 to 60 inches; gray (5Y 5/1) clay loam, light gray (5Y 6/1) dry; many medium prominent yellowish brown (10YR 5/4) mottles; massive; very hard, firm, sticky, and plastic; about 5 percent pebbles and coarse fragments; common nests and crystals of calcium sulfate; slight effervescence; mildly alkaline.

The thickness of the solum and the mollic epipedon is 8 to 16 inches. Depth to the calcic horizon is less than 16 inches. Reaction is mildly alkaline or moderately alkaline. Some pedons are saline.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1; or it is N 2/0 or N 3/0 (N 3/0 or N 4/0 dry).

The Cca horizon has hue of 2.5Y or 5Y, value of 4 or 5 (6 or 7 dry), and chroma of 1 or 2. It is loam or clay loam.

Vang series

The Vang series consists of deep, well drained soils on glacial outwash plains and stream terraces. Permeability of these soils is moderate in the solum and very rapid in the underlying material. These soils are moderately deep over sand and gravel that is mainly shale in origin. The soils formed in outwash containing a large amount of shale. Slope is 1 to 6 percent.

Vang soils are similar to the Fordville soils, and are near the Brantford, Binford, Coe, and Gardena soils. Fordville soils do not contain a high amount of shale particles in the IIC horizon. Brantford soils have a mollic epipedon less than 16 inches thick and are more shallow to shaly sand and gravel. Binford soils have a mollic epipedon less than 16 inches thick and are more shallow to shaly sand and gravel. In addition, Binford soils have less clay and more sand in the upper part of the pedon. Coe soils have a mollic epipedon less than 16 inches thick, have no cambic horizon, and are more shallow to shaly sand and gravel. Gardena soils have no shaly sand and gravel IIC horizon and have a coarse-silty 10- to 40-inch control section.

Typical pedon from an area of Vang loam, 1 to 3 percent slopes, 2,540 feet north and 684 feet west of the southeast corner of sec. 35, T. 151 N., R. 65 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure parting to weak fine granular; slightly hard, friable, nonsticky, and slightly plastic; neutral; abrupt smooth boundary.

A12—7 to 17 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to moderate fine subangular blocky; slightly hard, friable, nonsticky, and slightly plastic; neutral; clear wavy boundary.

B21—17 to 22 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky, and slightly plastic; neutral; clear wavy boundary.

B22—22 to 30 inches; dark brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; moderate medium prismatic structure parting to moderate fine subangular blocky in the upper part, and moderate fine subangular blocky structure in the lower part; slightly hard, friable, slightly sticky, and slightly plastic; neutral; gradual wavy boundary.

IIC—30 to 60 inches; olive (5Y 4/3) stratified shaly sand and gravel, pale olive (5Y 6/3) dry; single grain; loose, nonsticky, and nonplastic; about 30 percent gravel; slight effervescence; neutral.

The thickness of the solum is 16 to 30 inches. The depth to sand and gravel and carbonates is 20 to 40 inches.

The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. The B2 horizon has hue of 10YR or 2.5Y, value of 2 through 4 (4 through 6 dry), and chroma of 1 through 3. It contains up to 10 percent coarse fragments and is loam or clay loam. Some pedons have a B3 horizon.

The IIC horizon has hue of 2.5Y or 5Y, value of 3 through 6 (5 through 7 dry), and chroma of 1 through 4. It is stratified sand and gravel, of which about 60 percent is shale. Some pedons have a Cca horizon or contain lime accumulation in the upper part of the IIC horizon.

Zell series

The Zell series consists of deep, well drained, moderately permeable soils on glacial lake plains and in small lake basins on glacial uplands. These soils formed in medium textured glacial lacustrine sediment. Slope is 6 to 15 percent.

Zell soils are similar to the Eckman, Buse, and Esmond soils, and are near the Eckman and Gardena soils. Eckman soils have a thicker A horizon and a cambic horizon. The 10- to 40-inch control section of the Buse and Esmond soils are fine-loamy and coarse-loamy, respectively, and they formed in glacial till. Gar-

dena soils have a mollic epipedon more than 16 inches thick.

Typical pedon of Zell silt loam, from an area of Eckman-Zell silt loams, 6 to 9 percent slopes, 1,325 feet west and 220 feet south of the northeast corner of sec. 5, T. 153 N., R. 66 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; soft, friable, nonsticky, and slightly plastic; slight effervescence; moderately alkaline; clear smooth boundary.

A12—6 to 8 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to moderate fine subangular blocky; soft, friable, nonsticky, and slightly plastic; slight effervescence; moderately alkaline; clear smooth boundary.

AC—8 to 13 inches; very dark grayish brown (2.5Y 3/2) silt loam, grayish brown (2.5Y 5/2) dry; weak medium subangular blocky structure parting to moderate fine subangular blocky; soft, friable, nonsticky, and slightly plastic; strong effervescence; moderately alkaline; clear wavy boundary.

C1ca—13 to 29 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; soft, friable, nonsticky, and slightly plastic; violent effervescence; few fine irregularly shaped soft masses of lime; moderately alkaline; clear wavy boundary.

C2ca—29 to 38 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; massive; soft, friable, nonsticky, and slightly plastic; violent effervescence; moderately alkaline; clear wavy boundary.

C3—38 to 60 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; massive; soft, friable, nonsticky, and slightly plastic; strong effervescence; moderately alkaline.

The mollic epipedon is 6 to 16 inches thick. The A horizon has hue of 10YR, value of 2 or 3 (3 or 4 dry), and chroma of 1. The AC horizon has hue of 10YR or 2.5Y, value of 3 to 5 (5 or 6 dry), and chroma of 2 through 4. It is silt loam or very fine sandy loam. This horizon is absent in some pedons.

The C horizon has hue of 2.5Y or 5Y, value of 4 through 6 (6 through 8 dry), and chroma of 2 through 4. Typically, it is silt loam, but ranges to loam and very fine sandy loam. Some pedons have fine sandy loam or fine sand below a depth of 40 inches.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (9). Beginning

with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 17, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boroll (*Bor*, meaning cool, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploborolls (*Hapl*, meaning minimal horizonation, plus *boroll*, the suborder of the Mollisols that have a mean annual soil temperature of less than 47 degrees F).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Udic* identifies the subgroup that is more moist than the central concept of great group. An example is Udic Haploboroll.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, Udic Haploborolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

The texture of the surface layer or of the substratum can differ within a series.

Formation of the soils

Soil is produced by soil-forming processes acting on material deposited or accumulated by geological processes. The soil characteristics at any given point are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material has developed since accumulation, plant and animal life on and in the soil, the relief or lay of the land, and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life are active factors of soil formation. They act on the parent material that has accumulated from the weathering of rocks, and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for horizon differentiation. Usually a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor, unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

All the soils in the Benson County Area formed in glacial material derived from preglacial granite, gneiss, sandstone, shale, limestone, and basalt. The glacier picked up these materials, ground and mixed them as it advanced, and then deposited the materials as it melted. Some soils, such as Barnes and Svea soils, consist of unsorted material, or glacial till. Gardena and Eckman soils, for example, consist of material sorted by water deposition. Dickey and Hecla soils consist of material sorted by wind and water after deposition.

Climate

Benson County Area has a cool, dry-subhumid, continental climate characterized by long, cold winters and a short growing season during which the distribution of rainfall is erratic. The climate does not vary much from place to place and probably has not changed much during the period of soil formation. The climate is favorable for prairie vegetation.

Temperature and moisture affect the growth of plants, the activity of micro-organisms, and the speed of chemi-

cal reactions, particularly during the growing season. Rainfall has not been sufficient for the deep leaching of the soils, nor has it caused more than a minor amount of erosion. Freezing and thawing help to disintegrate parts of the glacial debris, and frost heaving helps mix soil materials, thus affecting soil structure. The cool temperatures slow the decay of plant and animal material, thus promoting the accumulation of organic matter. This process is responsible for the large amount of organic matter in the Aastad, Svea, and Emrick soils.

Plant and animal life

Soil formation started in the Benson County Area when plants began to grow in the unconsolidated material deposited by the glacier. Well drained soils, such as the Barnes and Heimdal, formed under predominantly cool season, drought resistant grasses. Tall, warm season grasses grow where the soils receive extra moisture. The Bottineau soils formed under woodland vegetation.

Plant roots loosen the soil material and bring minerals from the parent material upward toward the surface. As the plants die and decay, they contribute organic matter, which bacteria and other micro-organisms help to decompose. Thus, nutrients leached out of the surface layer are replaced, and a good supply is maintained for other plants.

Earthworms and burrowing animals help mix the soil material from various horizons, and bring some fresh parent material to the surface layer. Man's activities, particularly in altering drainage conditions, maintaining fertility, and changing the kinds of vegetation, have an important effect on the rate and the direction of future soil formation.

Relief

Relief influences the formation of soils by its effect on runoff and drainage. If other soil-forming factors are equal, relief largely determines the degree of profile development, mainly because it controls the amount of moisture in the soil. Because of excessive drainage, only a small amount of water is in the more sloping and coarser textured soils, consequently, vegetation is sparse and profile development is slow. Among the soils affected by excessive drainage are the Buse, Esmond, and Sioux soils. On the other hand, the excess water in areas that have poor drainage also disturbs the process of soil formation. The Parnell, Borup, Colvin, Tonka, and other soils are affected by poor drainage.

Time

Time is necessary for the soil forming factors to act on parent material. Generally, the length of time determines

whether the soil has reached an equilibrium with the environment.

The degree of profile development in most of the soils in the Benson County Area has been more affected by other differences than by the length of time, because the length of time has been about the same for all of these soils. In terms of geological time, the soils are young because they formed from material deposited in late Pleistocene time, which ended about 11,000 years ago.

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Glossary

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single mapping unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	<i>Inches</i>
Very low.....	0 to 3
Low.....	3 to 6
Moderate.....	6 to 9
High.....	More than 9

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured soil. Sand or loamy sand.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is 40 or 80 inches (1 or 2 meters).

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave. Unstable walls of cuts made by earth-moving equipment. The soil sloughs easily.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer

within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Excess salts. Excess water soluble salts. Excessive salts restrict the growth of most plants.

Fast intake. The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

Fine textured soil. Sandy clay, silty clay, and clay.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by melt water as it flows from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes by water originating mainly from the melting of glacial ice. Many are interbedded or laminated.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A₂ horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which

the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Miscellaneous areas. Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. Glacial outwash is commonly in valleys on landforms known as valley trains, outwash terraces, eskers, kame terraces, kames, outwash fans, or deltas.

Outwash plain. A land form of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in

the soil that affect its management. A soil series, for example, may be divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

Piping. Moving water of subsurface tunnels or pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Poor outlets. Surface or subsurface drainage outlets difficult or expensive to install.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid.....	Below 4.5
Very strongly acid.....	4.5 to 5.0
Strongly acid.....	5.1 to 5.5
Medium acid.....	5.6 to 6.0
Slightly acid.....	6.1 to 6.5
Neutral.....	6.6 to 7.3
Mildly alkaline.....	7.4 to 7.8
Moderately alkaline.....	7.9 to 8.4
Strongly alkaline.....	8.5 to 9.0
Very strongly alkaline.....	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Root zone. The part of the soil that can be penetrated by plant roots.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; contains harmful salts and is strongly alkaline; or contains harmful salts and exchangeable sodium and is very strongly alkaline. The salts, exchangeable sodium, and alkaline reaction are in the soil in such location that growth of most crop plants is less than normal.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are simi-

lar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slick spot. Locally, a small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake. The slow movement of water into the soil.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil, or partly worked into the soil, to provide protection from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt*, *silt loam*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within 1 year; specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION DATA

Month	Temperature ¹						Precipitation ¹				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have--		Average number of growing degree days ²	Average	2 years in 10 will have--		Average number of days with 0.10 inch or more	Average snowfall
				Maximum temperature higher than--	Minimum temperature lower than--			Less than--	More than--		
	<u>°F</u>	<u>°F</u>	<u>°F</u>	<u>°F</u>	<u>°F</u>	<u>Units</u>	<u>In</u>	<u>In</u>	<u>In</u>		<u>In</u>
January----	12.5	-7.2	2.6	41	-36	0	.78	.28	1.18	4	9.7
February---	20.3	-7	9.9	45	-32	0	.44	.15	.66	2	4.5
March-----	32.3	11.7	22.0	62	-24	43	.89	.30	1.36	3	8.2
April-----	51.7	28.9	40.3	83	5	128	1.38	.48	2.11	4	4.0
May-----	66.6	39.9	53.3	91	20	412	2.38	.97	3.51	6	.6
June-----	76.1	50.7	63.5	96	32	705	3.27	1.46	4.73	7	.0
July-----	81.9	54.8	68.4	100	39	880	2.41	1.46	3.25	5	.0
August-----	81.6	52.7	67.2	99	35	843	2.06	.98	2.92	5	.0
September--	68.6	41.9	55.3	95	22	459	1.83	.58	2.81	5	.2
October----	56.8	32.5	44.7	83	12	209	.93	.31	1.42	3	1.6
November---	35.0	16.9	26.0	64	-16	24	.61	.13	.97	3	4.2
December---	20.4	2.0	11.2	47	-32	0	.62	.30	.88	3	7.4
Year-----	50.3	27.0	38.7	101	-37	3,703	17.60	14.59	20.45	50	40.4

¹Recorded in the period 1951-74 at Leeds, N. Dakota.

²A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature ¹		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 17	May 28	June 7
2 years in 10 later than--	May 11	May 23	June 2
5 years in 10 later than--	April 28	May 14	May 24
First freezing temperature in fall:			
1 year in 10 earlier than--	September 16	September 8	August 26
2 years in 10 earlier than--	September 22	September 14	August 31
5 years in 10 earlier than--	October 4	September 24	September 11

¹Recorded in the period 1951-74 at Leeds, N. Dakota.

TABLE 3.--GROWING SEASON LENGTH

Probability	Daily minimum temperature during growing season ¹		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	132	111	87
8 years in 10	141	118	95
5 years in 10	158	133	110
2 years in 10	175	147	125
1 year in 10	184	154	133

¹Recorded in the period 1951-74
at Leeds, N. Dakota.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
3	Parnell silty clay loam-----	16,350	1.9
4	Fargo silty clay loam-----	2,390	0.3
5	Hegne silty clay-----	1,725	0.2
7	Colvin silt loam-----	1,980	0.2
8	Colvin silt loam, wet-----	2,035	0.2
9	Rauville silt loam-----	3,235	0.4
11	Svea-Barnes loams, 1 to 3 percent slopes-----	24,065	2.8
12B	Barnes-Svea loams, 3 to 6 percent slopes-----	78,500	9.0
13C	Barnes-Buse loams, 6 to 9 percent slopes-----	45,805	5.3
13D	Barnes-Buse loams, 9 to 15 percent slopes-----	12,605	1.5
14	Svea-Hamerly loams, 1 to 3 percent slopes-----	35,705	4.1
14B	Svea-Hamerly loams, 3 to 6 percent slopes-----	35,640	4.1
15	Vallers loam, saline, 1 to 3 percent slopes-----	13,270	1.5
16	Vallers loam-----	6,220	0.7
18E	Buse loam, 15 to 25 percent slopes-----	7,310	0.8
19	Tonka silt loam-----	6,185	0.7
21	Emrick-Heimdal loams, 1 to 3 percent slopes-----	59,850	6.9
22B	Heimdal-Emrick loams, 3 to 6 percent slopes-----	68,140	7.9
23C	Heimdal-Esmond loams, 6 to 9 percent slopes-----	22,725	2.6
24	Fram-Emrick loams, 1 to 3 percent slopes-----	32,370	3.7
25D	Esmond-Heimdal loams, 9 to 15 percent slopes-----	10,385	1.2
25E	Esmond-Heimdal loams, 15 to 25 percent slopes-----	3,755	0.4
26E	Esmond-Sioux loams, 9 to 25 percent slopes-----	5,465	0.6
27C	Barnes-Sioux loams, 3 to 9 percent slopes-----	4,965	0.6
28D	Barnes-Sioux loams, 9 to 15 percent slopes-----	4,265	0.5
30D	Barnes-Buse very stony loams, 6 to 25 percent slopes-----	8,240	0.9
31B	Towner fine sandy loam, 1 to 6 percent slopes-----	2,690	0.3
33C	Dickey fine sandy loam, 6 to 9 percent slopes-----	1,150	0.1
34	Embden-Heimdal complex, 1 to 3 percent slopes-----	1,090	0.1
34B	Embden-Heimdal complex, 3 to 6 percent slopes-----	4,410	0.5
34C	Embden-Heimdal complex, 6 to 9 percent slopes-----	1,830	0.2
41	Overly silty clay loam, 1 to 3 percent slopes-----	4,095	0.5
42	Gardena silt loam, 1 to 3 percent slopes-----	2,530	0.3
42B	Gardena-Eckman silt loams, 3 to 6 percent slopes-----	1,225	0.1
43C	Eckman-Zell silt loams, 6 to 9 percent slopes-----	810	0.1
44	Glyndon silt loam-----	1,055	0.1
45	Bearden silt loam-----	4,250	0.5
46	Borup silt loam-----	930	0.1
47	Fossum fine sandy loam-----	955	0.1
50B	Great Bend silt loam, 3 to 6 percent slopes-----	2,265	0.3
52B	Embden-Egeland fine sandy loams, 1 to 6 percent slopes-----	2,680	0.3
53	Hecla fine sandy loam, 1 to 3 percent slopes-----	1,860	0.2
54B	Hecla-Maddock fine sandy loams, 3 to 6 percent slopes-----	685	0.1
58	Hecla-Maddock loamy fine sands, 1 to 3 percent slopes-----	980	0.1
59B	Maddock-Hecla loamy fine sands, 3 to 6 percent slopes-----	1,840	0.2
59D	Maddock loamy fine sand, 6 to 15 percent slopes-----	1,445	0.2
61	Renshaw loam, 1 to 3 percent slopes-----	8,235	0.9
61B	Renshaw loam, 3 to 6 percent slopes-----	3,905	0.5
63	Brantford loam, 1 to 3 percent slopes-----	5,050	0.6
63B	Brantford loam, 3 to 6 percent slopes-----	5,460	0.6
63C	Brantford loam, 6 to 9 percent slopes-----	3,975	0.5
64	Divide loam, 1 to 3 percent slopes-----	6,520	0.8
65	Vang loam, 1 to 3 percent slopes-----	1,455	0.2
65B	Vang loam, 3 to 6 percent slopes-----	1,330	0.2
66	Marysland loam-----	3,895	0.4
67	Marysland loam, wet-----	640	0.1
68B	Arvilla sandy loam, 1 to 6 percent slopes-----	7,335	0.8
70B	Binford sandy loam, 1 to 6 percent slopes-----	445	0.1
71	Svea-Cresbard loams, 1 to 3 percent slopes-----	5,535	0.6
71B	Svea-Cresbard loams, 3 to 6 percent slopes-----	3,000	0.3
73	Larson-Cathay loams, 1 to 3 percent slopes-----	2,805	0.3
74B	Cavour-Miranda complex, 1 to 6 percent slopes-----	3,175	0.4
75	Ryan silty clay-----	5,015	0.6
78	LaDelle-Aberdeen silt loams-----	830	0.1
82B	Darnen loam, 3 to 6 percent slopes-----	1,640	0.2
83	LaDelle silt loam-----	1,220	0.1
85	Lamoure silt loam-----	1,885	0.2
86	LaDelle silt loam, channeled-----	2,380	0.3
89	Grano silty clay-----	2,930	0.3
90	Parnell and Lallie soils, ponded-----	27,865	3.2

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
91C	Sioux gravelly loam, 1 to 9 percent slopes-----	1,465	0.2
91E	Sioux gravelly loam, 9 to 25 percent slopes-----	3,115	0.4
98C	Coe shaly loam, 1 to 9 percent slopes-----	500	0.1
98E	Coe shaly loam, 9 to 25 percent slopes-----	5,845	0.7
99C	Claire loamy coarse sand, loamy substratum, 1 to 9 percent slopes-----	8,390	1.0
101	Lallie loam-----	11,515	1.3
104	Lallie loam, saline-----	4,140	0.5
106	Lallie loam, wet-----	3,160	0.4
107	Minnewaukan loamy fine sand, 1 to 3 percent slopes-----	3,410	0.4
109	Aquents-----	3,570	0.4
110B	Aastad-Bottineau loams, 3 to 6 percent slopes-----	4,460	0.5
112F	Edgeley Variant loam, 15 to 60 percent slopes-----	750	0.1
113C	Bottineau loam, 6 to 9 percent slopes-----	3,350	0.4
113D	Bottineau loam, 9 to 15 percent slopes-----	3,285	0.4
119	Aberdeen silty clay loam-----	3,935	0.5
122	Fram-Cathay loams, 1 to 3 percent slopes-----	4,585	0.5
123	Emrick-Cathay loams, 1 to 3 percent slopes-----	8,205	0.9
123B	Emrick-Cathay loams, 3 to 6 percent slopes-----	4,140	0.5
124C	Heimdal-Sioux loams, 3 to 9 percent slopes-----	4,410	0.5
125C	Heimdal-Emrick very stony loams, 1 to 9 percent slopes-----	1,485	0.2
125F	Heimdal-Esmond very stony loams, 9 to 40 percent slopes-----	13,205	1.5
126	Fram loam, saline, 1 to 3 percent slopes-----	8,065	0.9
127	Fram loam, 1 to 3 percent slopes-----	5,355	0.6
129	Colvin and Borup silt loams, saline-----	8,095	0.9
131D	Miranda Variant loam, 3 to 15 percent slopes-----	2,120	0.2
133	Fordville loam, 1 to 3 percent slopes-----	6,570	0.8
134	Borup-Vallers complex, 1 to 3 percent slopes-----	1,020	0.1
135	Miranda-Larson complex, 1 to 3 percent slopes-----	2,505	0.3
137	Stirum loamy fine sand-----	765	0.1
140B	Svea-Buse loams, 3 to 6 percent slopes-----	31,030	3.6
141	Embsen-Letcher fine sandy loams, 1 to 3 percent slopes-----	975	0.1
144	Hamerly-Cresbard loams, 1 to 3 percent slopes-----	3,625	0.4
144B	Hamerly-Cresbard loams, 3 to 6 percent slopes-----	2,310	0.3
145	Grano silty clay, saline-----	3,160	0.4
146	Hamerly-Tonka loams, 0 to 3 percent slopes-----	24,505	2.8
149B	Maddock loamy fine sand, 1 to 6 percent slopes-----	690	0.1
150	Pits, gravel-----	395	*
	Water-----	11,059	1.3
	Total-----	867,644	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Spring wheat	Oats	Barley	Flax	Grass-legume hay
	Bu	Bu	Bu	Bu	Ton
3----- Parnell**	30	63	48	13	2.5
4----- Fargo**	33	69	53	14	2.6
5----- Hegne**	30	63	48	13	2.5
7----- Colvin**	30	63	48	13	2.5
8----- Colvin	---	---	---	---	---
9----- Rauville	---	---	---	---	---
11----- Svea-Barnes	37	78	59	17	3.0
12B----- Barnes-Svea	35	73	56	15	2.7
13C----- Barnes-Buse	24	50	38	11	1.8
13D----- Barnes-Buse	21	44	34	9	1.7
14----- Svea-Hamerly	36	76	58	17	2.8
14B----- Svea-Hamerly	33	71	53	15	2.7
15----- Vallers**	21	44	34	9	2.4
16----- Vallers	30	63	48	13	2.8
18E----- Buse	---	---	---	---	---
19----- Tonka	31	65	50	16	2.5
21----- Emrick-Heimdal	37	78	59	17	3.0
22B----- Heimdal-Emrick	35	73	56	15	2.7
23C----- Heimdal-Esmond	25	53	40	11	2.1
24----- Fram-Emrick	36	76	58	16	2.8
25D----- Esmond-Heimdal	---	---	---	---	1.1
25E----- Esmond-Heimdal	---	---	---	---	---

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Flax	Grass-legume hay
	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Ton</u>
26E----- Esmond-Sioux	---	---	---	---	---
27C----- Barnes-Sioux	23	47	37	10	1.9
28D----- Barnes-Sioux	---	---	---	---	---
30D----- Barnes-Buse	---	---	---	---	---
31B----- Towner	22	44	34	10	2.4
33C----- Dickey	18	38	29	8	1.5
34----- Embden-Hiendal	30	63	48	13	2.8
34B----- Embden-Hiendal	25	50	38	11	1.9
34C----- Embden-Hiendal	21	44	34	9	1.7
41----- Overly	40	84	64	18	3.0
42----- Gardena	38	80	61	19	3.0
42B----- Gardena-Eckman	34	71	54	17	2.8
43C----- Eckman-Zell	25	53	40	11	2.1
44----- Glyndon	35	74	55	16	2.8
45----- Bearden	38	80	61	17	2.9
46----- Borup**	31	67	51	15	2.5
47----- Fossum**	25	53	40	11	2.1
50B----- Great Bend	32	80	61	17	2.9
52B----- Embden-Egeland	24	50	38	13	1.9
53----- Hecla	23	48	37	11	2.0
54B----- Hecla-Maddock	21	44	34	9	1.7
58----- Hecla-Maddock	18	37	28	9	1.6
59B----- Maddock-Hecla	14	29	22	6	1.3

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Flax	Grass-legume hay
	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Ton</u>
59D----- Maddock	---	---	---	---	---
61----- Renshaw	18	38	29	13	1.4
61B----- Renshaw	14	29	22	12	1.3
63----- Brantford	18	38	29	13	1.6
63B----- Brantford	14	29	22	12	1.4
63C----- Brantford	10	21	16	8	1.0
64----- Divide	23	48	37	13	2.0
65----- Vang	23	48	37	16	2.0
65B----- Vang	21	44	34	9	1.7
66----- Marysland**	24	50	38	13	2.3
67----- Marysland	---	---	---	---	---
68B----- Arvilla	14	29	22	12	1.3
70B----- Binford	17	35	27	7	1.4
71----- Svea-Cresbard	32	67	51	15	2.4
71B----- Svea-Cresbard	28	62	47	13	2.2
73----- Larson-Cathay	18	38	29	8	1.5
74B----- Cavour-Miranda	---	---	---	---	---
75----- Ryan	---	---	---	---	---
78----- LaDelle-Aberdeen	35	73	56	15	2.7
82B----- Darnen	35	73	56	15	2.7
83----- LaDelle	38	80	61	19	3.0
85----- Lamoure	17	36	27	7	1.4
86----- LaDelle	---	---	---	---	---

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Flax	Grass-legume hay
	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>Ton</u>
89----- Grano**	29	61	46	13	2.4
90----- Parnell and Lallie	---	---	---	---	---
91C----- Sioux	---	---	---	---	---
91E----- Sioux	---	---	---	---	---
98C----- Coe	---	---	---	---	1.0
98E----- Coe	---	---	---	---	---
99C----- Claire	---	---	---	---	---
101----- Lallie**	14	29	22	6	1.3
104, 106----- Lallie	---	---	---	---	---
107----- Minnewaukan	9	19	14	6	1.3
109*----- Aquents					
110B----- Aastad-Bottineau	35	73	56	15	2.7
112F----- Edgeley Variant	---	---	---	---	---
113C----- Bottineau	27	58	43	12	2.3
113D----- Bottineau	21	44	34	9	1.7
119----- Aberdeen	29	61	46	10	2.4
122----- Fram-Cathay	30	63	40	13	2.5
123----- Emrick-Cathay	33	69	53	14	2.6
123B----- Emrick-Cathay	30	63	48	13	2.5
124C----- Heimdal-Sioux	21	44	34	9	1.7
125C----- Heimdal-Emrick	---	---	---	---	---
125F----- Heimdal-Esmond	---	---	---	---	---
126----- Fram**	21	44	34	9	2.4

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Oats	Barley	Flax	Grass-legume hay
	Bu	Bu	Bu	Bu	Ton
127----- Fram**	30	63	48	13	2.8
129----- Colvin and Borup	14	29	22	6	2.0
131D----- Miranda Variant	---	---	---	---	---
133----- Fordville	22	46	35	14	1.6
134----- Borup-Vallers	---	---	---	---	---
135----- Miranda-Larson	---	---	---	---	---
137----- Stirum	10	21	16	6	1.4
140B----- Svea-Buse	30	63	48	13	2.5
141----- Embden-Letcher	23	47	37	10	1.9
144----- Hamerly-Cresbard	30	63	48	13	2.5
144B----- Hamerly-Cresbard	25	53	40	11	2.1
145----- Grano	---	---	---	---	---
146----- Hamerly-Tonka	29	61	46	13	2.4
149B----- Maddock	---	---	---	---	0.9
150*, Pits					

* See description of the map unit for composition and behavior characteristics of the map unit.

** Yields are for drained areas.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation are listed]

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight Lb/acre		Pct
3----- Parnell	Wetland-----	Favorable Normal Unfavorable	6,300 6,000 5,700	Slough sedge----- Rivergrass----- Northern reedgrass----- Prairie cordgrass-----	40 30 10 5
4----- Fargo	Clayey-----	Favorable Normal Unfavorable	3,200 2,750 2,300	Western wheatgrass----- Green needlegrass----- Kentucky bluegrass----- Streambank wheatgrass----- Blue grama----- Porcupinegrass----- Needleandthread-----	20 20 15 5 5 5 5
5----- Hegne	Clayey-----	Favorable Normal Unfavorable	4,000 3,600 3,200	Big bluestem----- Reed canarygrass----- Indiangrass----- Switchgrass----- Kentucky bluegrass----- Redtop----- Prairie cordgrass-----	25 10 10 10 10 5 5
7----- Colvin	Wet Meadow-----	Favorable Normal Unfavorable	5,900 4,950 4,000	Slim sedge----- Northern reedgrass----- Prairie cordgrass-----	70 5 5
8----- Colvin	Wetland-----	Favorable Normal Unfavorable	6,800 5,800 4,900	Slough sedge----- Rivergrass-----	50 30
9----- Rauville	Wetland-----	Favorable Normal Unfavorable	6,600 6,000 4,800	Prairie cordgrass----- Sedge----- Reedgrass-----	75 10 10
11*: Svea-----	Overflow-----	Favorable Normal Unfavorable	2,850 2,500 2,150	Western wheatgrass----- Needleandthread----- Green needlegrass----- Porcupinegrass----- Kentucky bluegrass----- Blue grama----- Sedge----- Western snowberry-----	15 15 10 10 10 5 5 5
Barnes-----	Silty-----	Favorable Normal Unfavorable	3,250 2,850 2,450	Western wheatgrass----- Needleandthread----- Green needlegrass----- Pennsylvania sedge----- Bearded wheatgrass----- Streambank wheatgrass----- Porcupinegrass----- Blue grama-----	15 15 15 6 5 5 5 5
12B*: Barnes-----	Silty-----	Favorable Normal Unfavorable	3,250 2,850 2,450	Western wheatgrass----- Needleandthread----- Green needlegrass----- Pennsylvania sedge----- Bearded wheatgrass----- Streambank wheatgrass----- Porcupinegrass----- Blue grama-----	15 15 15 6 5 5 5 5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight Lb/acre		
12B*: Svea-----	Silty-----	Favorable	2,850	Western wheatgrass-----	15
		Normal	2,500	Needleandthread-----	15
		Unfavorable	2,150	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Sedge-----	5
				Western snowberry-----	5
13C*, 13D*: Barnes-----	Silty-----	Favorable	3,250	Western wheatgrass-----	15
		Normal	2,850	Needleandthread-----	15
		Unfavorable	2,450	Green needlegrass-----	15
				Pennsylvania sedge-----	6
				Bearded wheatgrass-----	5
				Streambank wheatgrass-----	5
				Porcupinegrass-----	5
				Blue grama-----	5
Buse-----	Thin Upland-----	Favorable	3,800	Little bluestem-----	20
		Normal	3,200	Sideoats grama-----	15
		Unfavorable	2,800	Needleandthread-----	15
				Big bluestem-----	10
				Indiangrass-----	10
				Blue grama-----	10
				Prairie dropseed-----	5
				Green needlegrass-----	5
14*: Svea-----	Overflow-----	Favorable	2,850	Western wheatgrass-----	15
		Normal	2,500	Needleandthread-----	15
		Unfavorable	2,150	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Sedge-----	5
				Western snowberry-----	5
Hamerly-----	Silty-----	Favorable	3,100	Needleandthread-----	15
		Normal	2,700	Western wheatgrass-----	10
		Unfavorable	2,300	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Streambank wheatgrass-----	5
				Blue grama-----	5
				Bearded wheatgrass-----	5
				Pennsylvania sedge-----	5
14B*: Svea-----	Silty-----	Favorable	2,850	Western wheatgrass-----	15
		Normal	2,500	Needleandthread-----	15
		Unfavorable	2,150	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Sedge-----	5
				Western snowberry-----	5
Hamerly-----	Silty-----	Favorable	3,100	Needleandthread-----	15
		Normal	2,700	Western wheatgrass-----	10
		Unfavorable	2,300	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Streambank wheatgrass-----	5
				Blue grama-----	5
				Bearded wheatgrass-----	5
				Pennsylvania sedge-----	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight Lb/acre		Pct
15----- Vallers	Wet Meadow-----	Favorable	4,900	Slim sedge-----	70
		Normal	4,300	Northern reedgrass-----	5
		Unfavorable	3,700	Prairie cordgrass-----	5
16----- Vallers	Wet Meadow-----	Favorable	4,800	Wooly sedge-----	60
		Normal	4,400	Prairie cordgrass-----	10
		Unfavorable	4,000	Northern reedgrass-----	5
18E----- Buse	Thin Upland-----	Favorable	3,800	Little bluestem-----	20
		Normal	3,200	Sideoats grama-----	15
		Unfavorable	2,800	Needleandthread-----	15
				Big bluestem-----	10
				Indiangrass-----	10
				Blue grama-----	10
				Prairie dropseed-----	5
				Green needlegrass-----	5
19----- Tonka	Wet Meadow-----	Favorable	4,400	Slim sedge-----	30
		Normal	3,800	Woolyfruit sedge-----	25
		Unfavorable	3,200	Straw sedge-----	5
				Baltic rush-----	5
				Common spikesedge-----	5
				Northern reedgrass-----	5
				Prairie cordgrass-----	5
21*: Emrick-----	Silty-----	Favorable	2,900	Western wheatgrass-----	15
		Normal	2,500	Needleandthread-----	15
		Unfavorable	2,100	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Pennsylvania sedge-----	5
Heimdal-----	Silty-----	Favorable	2,750	Western wheatgrass-----	15
		Normal	2,400	Needleandthread-----	15
		Unfavorable	2,050	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Pennsylvania sedge-----	8
				Blue grama-----	5
22B*: Heimdal-----	Silty-----	Favorable	2,750	Western wheatgrass-----	15
		Normal	2,400	Needleandthread-----	15
		Unfavorable	2,050	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Pennsylvania sedge-----	8
				Blue grama-----	5
Emrick-----	Silty-----	Favorable	2,900	Western wheatgrass-----	15
		Normal	2,500	Needleandthread-----	15
		Unfavorable	2,100	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Pennsylvania sedge-----	5
23C*: Heimdal-----	Silty-----	Favorable	2,750	Western wheatgrass-----	15
		Normal	2,400	Needleandthread-----	15
		Unfavorable	2,050	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Pennsylvania sedge-----	8
				Blue grama-----	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight Lb/acre		
23C*: Esmond-----	Thin Upland-----	Favorable	2,650	Little bluestem-----	15
		Normal	2,200	Needleandthread-----	15
		Unfavorable	1,750	Porcupinegrass-----	7
				Prairie sandreed-----	5
				Western wheatgrass-----	5
				Sideoats grama-----	5
				Plains muhly-----	5
				Green needlegrass-----	5
				Kentucky bluegrass-----	5
24*: Fram-----	Silty-----	Favorable	3,200	Western wheatgrass-----	15
		Normal	2,750	Needleandthread-----	15
		Unfavorable	2,300	Green needlegrass-----	15
				Pennsylvania sedge-----	6
				Streambank wheatgrass-----	5
				Bearded wheatgrass-----	5
				Porcupinegrass-----	5
				Blue grama-----	5
Emrick-----	Silty-----	Favorable	2,900	Western wheatgrass-----	15
		Normal	2,500	Needleandthread-----	15
		Unfavorable	2,100	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Pennsylvania sedge-----	5
25D*, 25E*: Esmond-----	Thin Upland-----	Favorable	2,650	Little bluestem-----	15
		Normal	2,200	Needleandthread-----	15
		Unfavorable	1,750	Porcupinegrass-----	7
				Prairie sandreed-----	5
				Western wheatgrass-----	5
				Sideoats grama-----	5
				Plains muhly-----	5
				Green needlegrass-----	5
				Kentucky bluegrass-----	5
Heimdal-----	Silty-----	Favorable	2,750	Western wheatgrass-----	15
		Normal	2,400	Needleandthread-----	15
		Unfavorable	2,050	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Pennsylvania sedge-----	8
				Blue grama-----	5
26E*: Esmond-----	Thin Upland-----	Favorable	2,650	Little bluestem-----	15
		Normal	2,200	Needleandthread-----	15
		Unfavorable	1,750	Porcupinegrass-----	7
				Prairie sandreed-----	5
				Western wheatgrass-----	5
				Sideoats grama-----	5
				Plains muhly-----	5
				Green needlegrass-----	5
				Kentucky bluegrass-----	5
Sioux-----	Very Shallow-----	Favorable	1,920	Blue grama-----	40
		Normal	1,600	Needleandthread-----	20
		Unfavorable	960	Sedge-----	20
				Sideoats grama-----	10

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight Lb/acre		Pct
27C*, 28D*: Barnes-----	Silty-----	Favorable	3,250	Western wheatgrass-----	15
		Normal	2,850	Needleandthread-----	15
		Unfavorable	2,450	Green needlegrass-----	15
				Pennsylvania sedge-----	6
				Bearded wheatgrass-----	5
				Streambank wheatgrass-----	5
				Porcupinegrass-----	5
				Blue grama-----	5
Sioux-----	Very Shallow-----	Favorable	1,920	Blue grama-----	40
		Normal	1,600	Needleandthread-----	20
		Unfavorable	960	Sedge-----	20
				Sideoats grama-----	10
30D*: Barnes-----	Silty-----	Favorable	3,050	Western wheatgrass-----	15
		Normal	2,650	Needleandthread-----	15
		Unfavorable	2,250	Green needlegrass-----	15
				Pennsylvania sedge-----	6
				Bearded wheatgrass-----	5
				Streambank wheatgrass-----	5
				Porcupinegrass-----	5
				Blue grama-----	5
Buse-----	Thin Upland-----	Favorable	3,120	Little bluestem-----	30
		Normal	2,600	Western wheatgrass-----	15
		Unfavorable	1,820	Big bluestem-----	10
				Needleandthread-----	10
				Porcupinegrass-----	10
				Blue grama-----	5
31B----- Towner	Sandy-----	Favorable	3,300	Sedge-----	5
		Normal	2,850	Needleandthread-----	25
		Unfavorable	2,400	Prairie sandreed-----	15
				Kentucky bluegrass-----	10
				Blue grama-----	5
33C----- Dickey	Sandy-----	Favorable	3,150	Western wheatgrass-----	5
		Normal	2,700	Needleandthread-----	25
		Unfavorable	2,250	Prairie sandreed-----	15
				Kentucky bluegrass-----	10
				Blue grama-----	5
34*, 34B*, 34C*: Embsen-----	Sandy-----	Favorable	3,300	Western wheatgrass-----	5
		Normal	2,850	Prairie sandreed-----	15
		Unfavorable	2,400	Kentucky bluegrass-----	10
				Blue grama-----	7
				Western wheatgrass-----	5
				Prairie junegrass-----	5
				Pennsylvania sedge-----	5
Heimdal-----	Silty-----	Favorable	2,750	Western wheatgrass-----	15
		Normal	2,400	Needleandthread-----	15
		Unfavorable	2,050	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Pennsylvania sedge-----	8
				Blue grama-----	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight Lb/acre		
41----- Overly	Silty-----	Favorable	3,250	Western wheatgrass-----	15
		Normal	2,850	Needleandthread-----	15
		Unfavorable	2,450	Green needlegrass-----	15
				Pennsylvania sedge-----	8
				Bearded wheatgrass-----	5
				Streambank wheatgrass-----	5
				Porcupinegrass-----	5
42----- Gardena	Silty-----	Favorable	3,100	Western wheatgrass-----	15
		Normal	2,750	Needleandthread-----	15
		Unfavorable	2,300	Green needlegrass-----	15
				Pennsylvania sedge-----	6
				Streambank wheatgrass-----	5
				Bearded wheatgrass-----	5
				Porcupinegrass-----	5
42B*: Gardena-----	Silty-----	Favorable	3,100	Western wheatgrass-----	15
		Normal	2,750	Needleandthread-----	15
		Unfavorable	2,300	Green needlegrass-----	15
				Pennsylvania sedge-----	6
				Streambank wheatgrass-----	5
				Bearded wheatgrass-----	5
				Porcupinegrass-----	5
Eckman-----	Silty-----	Favorable	3,000	Western wheatgrass-----	15
		Normal	2,550	Needleandthread-----	15
		Unfavorable	2,100	Green needlegrass-----	15
				Pennsylvania sedge-----	6
				Streambank wheatgrass-----	5
				Bearded wheatgrass-----	5
				Porcupinegrass-----	5
43C*: Eckman-----	Silty-----	Favorable	3,000	Western wheatgrass-----	15
		Normal	2,550	Needleandthread-----	15
		Unfavorable	2,100	Green needlegrass-----	15
				Pennsylvania sedge-----	6
				Streambank wheatgrass-----	5
				Bearded wheatgrass-----	5
				Porcupinegrass-----	5
Zell-----	Thin Upland-----	Favorable	3,240	Little bluestem-----	20
		Normal	2,700	Western wheatgrass-----	20
		Unfavorable	1,890	Sideoats grama-----	15
				Needleandthread-----	10
				Blue grama-----	10
				Big bluestem-----	5
				Prairie dropseed-----	5
44----- Glyndon	Silty-----	Favorable	3,600	Big bluestem-----	20
		Normal	3,200	Western wheatgrass-----	15
		Unfavorable	2,800	Switchgrass-----	10
				Kentucky bluegrass-----	10
				Little bluestem-----	10
				Indiangrass-----	10
				Porcupinegrass-----	10

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight Lb/acre		Pct
45----- Bearden	Subirrigated-----	Favorable	4,600	Big bluestem-----	35
		Normal	4,000	Switchgrass-----	20
		Unfavorable	3,400	Kentucky bluegrass-----	8
				Sedge-----	8
				Little bluestem-----	5
				Western wheatgrass-----	5
46----- Borup	Wet Meadow-----	Favorable	5,000	Big bluestem-----	25
		Normal	3,800	Reed canarygrass-----	10
		Unfavorable	3,400	Switchgrass-----	10
				Indiangrass-----	10
				Kentucky bluegrass-----	10
				Redtop-----	5
				Prairie cordgrass-----	5
47----- Fossum	Wet Meadow-----	Favorable	5,000	Big bluestem-----	30
		Normal	3,800	Indiangrass-----	20
		Unfavorable	3,400	Switchgrass-----	10
				Prairie cordgrass-----	10
				Reed canarygrass-----	10
50B----- Great Bend	Silty-----	Favorable	3,120	Western wheatgrass-----	30
		Normal	2,600	Green needlegrass-----	20
		Unfavorable	1,820	Little bluestem-----	10
				Needleandthread-----	10
				Sideoats grama-----	10
				Big bluestem-----	5
				Blue grama-----	5
				Sedge-----	5
52B*: Embden-----	Sandy-----	Favorable	3,300	Needleandthread-----	20
		Normal	2,850	Prairie sandreed-----	15
		Unfavorable	2,400	Kentucky bluegrass-----	10
				Blue grama-----	7
				Western wheatgrass-----	5
				Prairie junegrass-----	5
				Pennsylvania sedge-----	5
Egeland-----	Sandy-----	Favorable	3,480	Little bluestem-----	25
		Normal	2,900	Prairie sandreed-----	20
		Unfavorable	2,030	Needlegrass-----	15
				Big bluestem-----	10
				Western wheatgrass-----	10
				Sideoats grama-----	10
				Blue grama-----	5
53----- Hecla	Sandy-----	Favorable	3,360	Sand bluestem-----	25
		Normal	2,800	Little bluestem-----	25
		Unfavorable	1,960	Prairie sandreed-----	20
				Needleandthread-----	10
				Switchgrass-----	5
				Canada wildrye-----	5
				Sedge-----	5
54B*: Hecla-----	Sandy-----	Favorable	3,360	Sand bluestem-----	25
		Normal	2,800	Little bluestem-----	25
		Unfavorable	1,960	Prairie sandreed-----	20
				Needleandthread-----	10
				Switchgrass-----	5
				Canada wildrye-----	5
				Sedge-----	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight Lb/acre		
54B*; Maddock-----	Sandy-----	Favorable	3,400	Prairie sandreed-----	20
		Normal	2,950	Needleandthread-----	15
		Unfavorable	2,500	Kentucky bluegrass-----	10
				Pennsylvania sedge-----	10
				Blue grama-----	5
				Sand bluestem-----	5
				Western wheatgrass-----	5
58*; Hecla-----	Sands-----	Favorable	3,360	Sand bluestem-----	25
		Normal	2,800	Little bluestem-----	25
		Unfavorable	1,960	Prairie sandreed-----	20
				Needleandthread-----	10
				Switchgrass-----	5
				Canada wildrye-----	5
				Sedge-----	5
Maddock-----	Sands-----	Favorable	3,400	Prairie sandreed-----	20
		Normal	2,950	Needleandthread-----	15
		Unfavorable	2,500	Kentucky bluegrass-----	10
				Pennsylvania sedge-----	8
				Blue grama-----	5
				Sand bluestem-----	5
59B*; Maddock-----	Sands-----	Favorable	3,400	Prairie sandreed-----	20
		Normal	2,950	Needleandthread-----	15
		Unfavorable	2,500	Kentucky bluegrass-----	10
				Pennsylvania sedge-----	8
				Blue grama-----	5
				Sand bluestem-----	5
Hecla-----	Sands-----	Favorable	3,360	Sand bluestem-----	25
		Normal	2,800	Little bluestem-----	25
		Unfavorable	1,960	Prairie sandreed-----	20
				Needleandthread-----	10
				Switchgrass-----	5
				Canada wildrye-----	5
				Sedge-----	5
59D----- Maddock	Sands-----	Favorable	3,400	Prairie sandreed-----	20
		Normal	2,950	Needleandthread-----	15
		Unfavorable	2,500	Kentucky bluegrass-----	10
				Pennsylvania sedge-----	8
				Blue grama-----	5
				Sand bluestem-----	5
61, 61B----- Renshaw	Shallow To Gravel-----	Favorable	2,520	Needleandthread-----	35
		Normal	2,100	Little bluestem-----	15
		Unfavorable	1,260	Sideoats grama-----	15
				Blue grama-----	10
				Plains muhly-----	5
63, 63B, 63C----- Brantford	Shallow To Gravel-----	Favorable	2,150	Needleandthread-----	30
		Normal	1,850	Western wheatgrass-----	15
		Unfavorable	1,550	Blue grama-----	10
				Green needlegrass-----	5
				Kentucky bluegrass-----	5
64----- Divide	Silty-----	Favorable	3,100	Needleandthread-----	15
		Normal	2,700	Western wheatgrass-----	10
		Unfavorable	2,300	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Bearded wheatgrass-----	5
				Pennsylvania sedge-----	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight Lb/acre		
65, 65B----- Vang	Silty-----	Favorable	2,850	Western wheatgrass-----	15
		Normal	2,450	Needleandthread-----	15
		Unfavorable	2,050	Green needlegrass-----	15
				Pennsylvania sedge-----	6
				Bearded wheatgrass-----	5
				Streambank wheatgrass-----	5
				Porcupinegrass-----	5
66----- Marysland	Subirrigated-----	Favorable	5,940	Big bluestem-----	60
		Normal	5,400	Indiangrass-----	10
		Unfavorable	4,320	Switchgrass-----	10
				Sedge-----	10
				Prairie cordgrass-----	5
67----- Marysland	Wetland-----	Favorable	5,940	Big bluestem-----	60
		Normal	5,400	Indiangrass-----	10
		Unfavorable	4,320	Switchgrass-----	10
				Sedge-----	10
				Prairie cordgrass-----	5
68B----- Arvilla	Shallow To Gravel-----	Favorable	2,150	Needleandthread-----	25
		Normal	1,850	Western wheatgrass-----	20
		Unfavorable	1,550	Blue grama-----	10
				Pennsylvania sedge-----	6
				Green needlegrass-----	5
70B----- Binford	Shallow To Gravel-----	Favorable	2,100	Needleandthread-----	30
		Normal	1,700	Western wheatgrass-----	15
		Unfavorable	1,400	Blue grama-----	10
				Green needlegrass-----	5
				Kentucky bluegrass-----	5
				Porcupinegrass-----	5
				Pennsylvania sedge-----	5
71*: Svea-----	Overflow-----	Favorable	2,850	Western wheatgrass-----	15
		Normal	2,500	Needleandthread-----	15
		Unfavorable	2,150	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Sedge-----	5
				Western snowberry-----	5
Cresbard-----	Clayey-----	Favorable	3,000	Green needlegrass-----	40
		Normal	2,500	Western wheatgrass-----	10
		Unfavorable	1,750	Sideoats grama-----	10
				Blue grama-----	10
				Little bluestem-----	5
71B*: Svea-----	Silty-----	Favorable	2,850	Western wheatgrass-----	15
		Normal	2,500	Needleandthread-----	15
		Unfavorable	2,150	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Sedge-----	5
				Western snowberry-----	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight Lb/acre		Pct
71B*: Cresbard-----	Clayey-----	Favorable	3,000	Green needlegrass-----	40
		Normal	2,500	Western wheatgrass-----	10
		Unfavorable	1,750	Sideoats grama-----	10
				Blue grama-----	10
				Little bluestem-----	5
				Sedge-----	5
73*: Larson-----	Claypan-----	Favorable	2,200	Western wheatgrass-----	30
		Normal	1,800	Blue grama-----	15
		Unfavorable	1,400	Green needlegrass-----	10
				Needleandthread-----	10
				Prairie junegrass-----	5
				Porcupinegrass-----	5
				Kentucky bluegrass-----	5
				Needleleaf sedge-----	5
Cathay-----	Clayey-----	Favorable	2,750	Green needlegrass-----	20
		Normal	2,400	Western wheatgrass-----	20
		Unfavorable	2,050	Kentucky bluegrass-----	15
				Porcupinegrass-----	5
				Needleandthread-----	5
				Blue grama-----	5
74B*: Cavour-----	Claypan-----	Favorable	2,520	Western wheatgrass-----	45
		Normal	2,100	Green needlegrass-----	20
		Unfavorable	1,470	Blue grama-----	15
				Sedge-----	10
				Buffalograss-----	5
Miranda-----	Thin Claypan-----	Favorable	1,680	Blue grama-----	30
		Normal	1,400	Western wheatgrass-----	15
		Unfavorable	840	Buffalograss-----	10
				Sedge-----	10
				Needleandthread-----	5
				Inland saltgrass-----	5
				Grizzlybear pricklypear-----	5
75----- Ryan	Thin Claypan-----	Favorable	1,300	Western wheatgrass-----	50
		Normal	1,000	Blue grama-----	20
		Unfavorable	700	Prairie junegrass-----	5
				Inland saltgrass-----	5
78*: LaDelle-----	Overflow-----	Favorable	4,800	Big bluestem-----	55
		Normal	4,000	Green needlegrass-----	20
		Unfavorable	2,800	Indiangrass-----	5
				Leadplant-----	5
				Sedge-----	5
				Switchgrass-----	5
Aberdeen-----	Clayey-----	Favorable	2,750	Western wheatgrass-----	35
		Normal	2,400	Green needlegrass-----	30
		Unfavorable	2,050	Sideoats grama-----	10
				Little bluestem-----	5
				Big bluestem-----	5
				Blue grama-----	5
				Sedge-----	5
82B----- Darnen	Silty-----	Favorable	5,500	Big bluestem-----	20
		Normal	5,000	Little bluestem-----	10
		Unfavorable	4,500	Indiangrass-----	10
				Western wheatgrass-----	10
				Needleandthread-----	10
				Blue grama-----	10
				Sideoats grama-----	10
				Switchgrass-----	5
				Tall dropseed-----	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight Lb/acre		Pct
83----- LaDelle	Overflow-----	Favorable	4,800	Big bluestem-----	55
		Normal	4,000	Green needlegrass-----	20
		Unfavorable	2,800	Indiangrass-----	5
				Leadplant-----	5
				Sedge-----	5
				Switchgrass-----	5
85----- Lamoure	Subirrigated-----	Favorable	5,830	Big bluestem-----	60
		Normal	5,300	Switchgrass-----	10
		Unfavorable	4,240	Sedge-----	10
				Indiangrass-----	5
				Kentucky bluegrass-----	5
86----- LaDelle	Overflow-----	Favorable	4,800	Big bluestem-----	55
		Normal	4,000	Green needlegrass-----	20
		Unfavorable	2,800	Indiangrass-----	5
				Leadplant-----	5
				Sedge-----	5
				Switchgrass-----	5
89----- Grano	Wetland-----	Favorable	6,800	Slough sedge-----	35
		Normal	6,000	Rivergrass-----	30
		Unfavorable	5,500	Wooly sedge-----	10
				Slim sedge-----	5
91C, 91E----- Sioux	Very Shallow-----	Favorable	1,920	Blue grama-----	40
		Normal	1,600	Needleandthread-----	20
		Unfavorable	960	Sedge-----	20
				Sideoats grama-----	10
98C, 98E----- Coe	Very Shallow-----	Favorable	1,100	Needleandthread-----	35
		Normal	900	Blue grama-----	10
		Unfavorable	750	Western wheatgrass-----	5
				Prairie junegrass-----	5
				Fringed sagebrush-----	5
99C----- Claire	Sands-----	Favorable	2,300	Prairie sandreed-----	30
		Normal	2,000	Needleandthread-----	20
		Unfavorable	1,700	Sand bluestem-----	5
				Canada wildrye-----	5
				Kentucky bluegrass-----	5
				Green sagewort-----	5
101----- Lallie	Wetland-----	Favorable	6,800	Slough sedge-----	35
		Normal	6,000	Rivergrass-----	35
		Unfavorable	5,200		
104----- Lallie	Wetland-----	Favorable	3,400	Western wheatgrass-----	30
		Normal	3,000	Foxtail barley-----	25
		Unfavorable	2,600	Nuttall alkaligrass-----	15
				Slender wheatgrass-----	10
106----- Lallie	Wetland-----	Favorable	6,800	Slough sedge-----	35
		Normal	6,000	Rivergrass-----	35
		Unfavorable	5,200		
107----- Minnewaukan	Subirrigated-----	Favorable	4,800	Big bluestem-----	35
		Normal	4,200	Switchgrass-----	20
		Unfavorable	3,600	Kentucky bluegrass-----	8
				Little bluestem-----	5
				Western wheatgrass-----	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight Lb/acre		Pct
110B*: Aastad-----	Overflow-----	Favorable	2,800	Green needlegrass-----	20
		Normal	2,400	Porcupinegrass-----	15
		Unfavorable	2,000	Needleandthread-----	15
				Western wheatgrass-----	10
				Big bluestem-----	5
Bottineau-----	Savannah-----	Favorable	3,350	Needleandthread-----	15
		Normal	2,900	Western wheatgrass-----	10
		Unfavorable	2,450	Kentucky bluegrass-----	10
				Little bluestem-----	5
				Green needlegrass-----	5
112F----- Edgeley Variant	Savannah-----	Favorable	3,000	Green needlegrass-----	10
		Normal	2,600	Needleandthread-----	10
		Unfavorable	2,150	Western wheatgrass-----	10
				Little bluestem-----	5
				Blue grama-----	5
113C, 113D----- Bottineau	Savannah-----	Favorable	3,350	Needleandthread-----	15
		Normal	2,900	Western wheatgrass-----	10
		Unfavorable	2,450	Kentucky bluegrass-----	10
				Little bluestem-----	5
				Green needlegrass-----	5
119----- Aberdeen	Clayey-----	Favorable	2,750	Needleandthread-----	15
		Normal	2,400	Western wheatgrass-----	30
		Unfavorable	2,050	Sideoats grama-----	10
				Little bluestem-----	5
				Big bluestem-----	5
122*: Fram-----	Silty-----	Favorable	3,200	Blue grama-----	5
		Normal	2,750	Sedge-----	5
		Unfavorable	2,300	Western wheatgrass-----	15
				Needleandthread-----	15
				Green needlegrass-----	15
Cathay-----	Clayey-----	Favorable	2,750	Pennsylvania sedge-----	6
		Normal	2,400	Streambank wheatgrass-----	5
		Unfavorable	2,050	Bearded wheatgrass-----	5
				Porcupinegrass-----	5
				Blue grama-----	5
123*, 123B*: Emrick-----	Silty-----	Favorable	2,900	Needleandthread-----	5
		Normal	2,500	Green needlegrass-----	20
		Unfavorable	2,100	Western wheatgrass-----	20
				Needleandthread-----	15
				Green needlegrass-----	10
Cathay-----	Clayey-----	Favorable	2,900	Porcupinegrass-----	10
		Normal	2,500	Kentucky bluegrass-----	10
		Unfavorable	2,100	Blue grama-----	5
				Pennsylvania sedge-----	5
				Needleandthread-----	5
Cathay-----	Clayey-----	Favorable	2,750	Green needlegrass-----	20
		Normal	2,400	Western wheatgrass-----	20
		Unfavorable	2,050	Kentucky bluegrass-----	15
				Porcupinegrass-----	5
				Needleandthread-----	5
Cathay-----	Clayey-----	Favorable	2,750	Blue grama-----	5
		Normal	2,400	Needleandthread-----	5
		Unfavorable	2,050	Green needlegrass-----	20
				Western wheatgrass-----	20
				Kentucky bluegrass-----	15

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight Lb/acre		
124C*: Heimdal-----	Silty-----	Favorable	2,750	Western wheatgrass-----	15
		Normal	2,400	Needleandthread-----	15
		Unfavorable	2,050	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Pennsylvania sedge-----	8
				Blue grama-----	5
124C*: Sioux-----	Very Shallow-----	Favorable	1,920	Blue grama-----	40
		Normal	1,600	Needleandthread-----	20
		Unfavorable	960	Sedge-----	20
				Sideoats grama-----	10
125C*: Heimdal-----	Silty-----	Favorable	2,750	Western wheatgrass-----	15
		Normal	2,400	Needleandthread-----	15
		Unfavorable	2,050	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Pennsylvania sedge-----	5
Emrick-----	Silty-----	Favorable	2,900	Western wheatgrass-----	15
		Normal	2,500	Needleandthread-----	15
		Unfavorable	2,100	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Pennsylvania sedge-----	5
125F*: Heimdal-----	Silty-----	Favorable	2,750	Western wheatgrass-----	15
		Normal	2,400	Needleandthread-----	15
		Unfavorable	2,050	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Pennsylvania sedge-----	5
Esmond-----	Thin Upland-----	Favorable	2,650	Little bluestem-----	15
		Normal	2,200	Needleandthread-----	15
		Unfavorable	1,750	Porcupinegrass-----	7
				Prairie sandreed-----	5
				Western wheatgrass-----	5
				Sideoats grama-----	5
				Plains muhly-----	5
				Green needlegrass-----	5
				Kentucky bluegrass-----	5
126----- Fram	Silty-----	Favorable	3,200	Western wheatgrass-----	15
		Normal	2,750	Needleandthread-----	15
		Unfavorable	2,300	Green needlegrass-----	15
				Streambank wheatgrass-----	5
				Bearded wheatgrass-----	5
				Porcupinegrass-----	5
				Pennsylvania sedge-----	5
				Blue grama-----	5
127----- Fram	Silty-----	Favorable	3,200	Western wheatgrass-----	15
		Normal	2,750	Needleandthread-----	15
		Unfavorable	2,300	Green needlegrass-----	15
				Pennsylvania sedge-----	6
				Streambank wheatgrass-----	5
				Bearded wheatgrass-----	5
				Porcupinegrass-----	5
				Blue grama-----	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight Lb/acre		
129*: Colvin-----	Wet Meadow-----	Favorable	4,500	Slim sedge-----	30
		Normal	4,000	Woolyfruit sedge-----	15
		Unfavorable	3,500	Prairie cordgrass-----	15
				Northern reedgrass-----	5
				Switchgrass-----	5
				Straw sedge-----	5
129*: Borup-----	Wet Meadow-----	Favorable	4,900	Slim sedge-----	70
		Normal	4,300	Northern reedgrass-----	5
		Unfavorable	3,700	Prairie cordgrass-----	5
131D----- Miranda Variant	Thin Claypan-----	Favorable	1,680	Blue grama-----	30
		Normal	1,400	Western wheatgrass-----	15
		Unfavorable	840	Buffalograss-----	10
				Sedge-----	10
				Needleandthread-----	5
				Inland saltgrass-----	5
				Grizzlybear pricklypear-----	5
133----- Fordville	Silty-----	Favorable	3,000	Little bluestem-----	30
		Normal	2,500	Needlegrass-----	20
		Unfavorable	1,750	Western wheatgrass-----	10
				Sideoats grama-----	10
				Big bluestem-----	5
				Blue grama-----	5
				Sedge-----	5
134*: Borup-----	Wet Meadow-----	Favorable	5,000	Big bluestem-----	25
		Normal	3,800	Reed canarygrass-----	10
		Unfavorable	3,400	Switchgrass-----	10
				Indiangrass-----	10
				Kentucky bluegrass-----	10
				Redtop-----	5
				Prairie cordgrass-----	5
Vallers-----	Wet Meadow-----	Favorable	4,800	Wooly sedge-----	60
		Normal	4,400	Prairie cordgrass-----	10
		Unfavorable	4,000	Northern reedgrass-----	5
135*: Miranda-----	Thin Claypan-----	Favorable	1,680	Blue grama-----	30
		Normal	1,400	Western wheatgrass-----	15
		Unfavorable	840	Buffalograss-----	10
				Sedge-----	10
				Needleandthread-----	5
				Inland saltgrass-----	5
				Grizzlybear pricklypear-----	5
Larson-----	Claypan-----	Favorable	2,200	Western wheatgrass-----	30
		Normal	1,800	Blue grama-----	15
		Unfavorable	1,400	Green needlegrass-----	10
				Needleandthread-----	10
				Prairie junegrass-----	5
				Porcupinegrass-----	5
				Kentucky bluegrass-----	5
				Needleleaf sedge-----	5
137----- Stirum	Subirrigated-----	Favorable	4,800	Big bluestem-----	35
		Normal	4,200	Switchgrass-----	20
		Unfavorable	3,600	Kentucky bluegrass-----	8
				Little bluestem-----	5
				Western wheatgrass-----	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight Lb/acre		Pct
140B*: Svea-----	Silty-----	Favorable	2,850	Western wheatgrass-----	15
		Normal	2,500	Needleandthread-----	15
		Unfavorable	2,150	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Blue grama-----	5
				Sedge-----	5
				Western snowberry-----	5
140B*: Buse-----	Thin Upland-----	Favorable	3,800	Little bluestem-----	20
		Normal	3,200	Sideoats grama-----	15
		Unfavorable	2,800	Needleandthread-----	15
				Big bluestem-----	10
				Indiangrass-----	10
				Blue grama-----	10
				Prairie dropseed-----	5
				Green needlegrass-----	5
141*: Emden-----	Sandy-----	Favorable	3,300	Needleandthread-----	20
		Normal	2,850	Prairie sandreed-----	15
		Unfavorable	2,400	Kentucky bluegrass-----	10
				Blue grama-----	7
				Western wheatgrass-----	5
				Prairie junegrass-----	5
				Pennsylvania sedge-----	5
Letcher-----	Claypan-----	Favorable	3,240	Little bluestem-----	25
		Normal	2,700	Needleandthread-----	20
		Unfavorable	1,890	Prairie sandreed-----	10
				Western wheatgrass-----	10
				Sideoats grama-----	10
				Blue grama-----	10
				Switchgrass-----	5
				Big bluestem-----	5
144*, 144B*: Hamerly-----	Silty-----	Favorable	3,100	Needleandthread-----	15
		Normal	2,700	Western wheatgrass-----	10
		Unfavorable	2,300	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Streambank wheatgrass-----	5
				Blue grama-----	5
				Bearded wheatgrass-----	5
				Pennsylvania sedge-----	5
Cresbard-----	Clayey-----	Favorable	3,000	Green needlegrass-----	40
		Normal	2,500	Western wheatgrass-----	10
		Unfavorable	1,750	Sideoats grama-----	10
				Blue grama-----	10
				Little bluestem-----	5
				Sedge-----	5
145----- Grano	Wetland-----	Favorable	3,400	Western wheatgrass-----	30
		Normal	3,000	Foxtail barley-----	25
		Unfavorable	2,600	Nuttall alkaligrass-----	15
				Slender wheatgrass-----	10

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight Lb/acre		
146*: Hamerly-----	Silty-----	Favorable	3,100	Needleandthread-----	15
		Normal	2,700	Western wheatgrass-----	10
		Unfavorable	2,300	Green needlegrass-----	10
				Porcupinegrass-----	10
				Kentucky bluegrass-----	10
				Streambank wheatgrass-----	5
				Blue grama-----	5
				Bearded wheatgrass-----	5
				Pennsylvania sedge-----	5
146*: Tonka-----	Wet Meadow-----	Favorable	4,400	Slim sedge-----	30
		Normal	3,800	Woollyfruit sedge-----	25
		Unfavorable	3,200	Straw sedge-----	5
				Baltic rush-----	5
				Common spikesedge-----	5
				Northern reedgrass-----	5
				Prairie cordgrass-----	5
149B----- Maddock	Sands-----	Favorable	3,400	Prairie sandreed-----	20
		Normal	2,950	Needleandthread-----	15
		Unfavorable	2,500	Kentucky bluegrass-----	10
				Pennsylvania sedge-----	8
				Blue grama-----	5
				Sand bluestem-----	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	8	8-15	16-25	26-35	>35
3. Parnell					
4----- Fargo	---	Common chokecherry, Rocky Mt. juniper, American plum, Siberian peashrub, Tatarian honeysuckle.	Ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm, American elm, green ash.	Eastern cottonwood.
5----- Hegne	---	Tall purple willow, redosier dogwood, Tatarian honeysuckle, Siberian peashrub.	Russian-olive, eastern redcedar, northern white-cedar.	Green ash, American elm.	Eastern cottonwood, golden willow, Siberian elm.
7, 8. Colvin					
9. Rauville					
11*: Svea-----	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, Black Hills spruce, blue spruce, green ash, ponderosa pine, common chokecherry, eastern redcedar.	Siberian elm-----	Eastern cottonwood.
Barnes-----	--	Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine, eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive.	Siberian elm-----	---
12B*: Barnes-----	---	Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine, eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive.	Siberian elm-----	---
Svea-----	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, Black Hills spruce, blue spruce, green ash, ponderosa pine, common chokecherry, eastern redcedar.	Siberian elm-----	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	8	0-15	16-25	26-35	>35
13C*: Barnes-----	--	Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine, eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive.	Siberian elm-----	---
Buse-----	Lilac, American plum.	Eastern redcedar, common hackberry, Russian-olive, Siberian peashrub, Tatarian honeysuckle.	White spruce, ponderosa pine, Siberian elm, green ash.	---	---
13D*: Barnes-----	---	Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine, eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive.	Siberian elm-----	---
Buse.					
14*, 14B*: Svea-----	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, Black Hills spruce, blue spruce, green ash, ponderosa pine, common chokecherry, eastern redcedar.	Siberian elm-----	Eastern cottonwood.
Hamerly-----	---	Eastern redcedar, American plum, common chokecherry, Siberian peashrub.	Ponderosa pine, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm, American elm, green ash.	Eastern cottonwood.
15. Valliers					
16----- Valliers	---	Tall purple willow, redosier dogwood, Tatarian honeysuckle, Siberian peashrub.	Russian-olive, Black Hills spruce, eastern redcedar, northern white-cedar.	Golden willow, green ash.	Eastern cottonwood, Siberian elm.
18E. Buse					
19----- Tonka	Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, Rocky Mt. juniper, common chokecherry.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm-----	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
21*: Emrick-----	---	Eastern redcedar, Rocky Mt. juniper, common chokecherry, Siberian peashrub.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, Russian- olive.	Siberian elm-----	Eastern cottonwood.
Heimdal-----	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine.	Siberian elm-----	---
22B*: Heimdal-----	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine.	Siberian elm-----	---
Emrick-----	---	Eastern redcedar, Rocky Mt. juniper, common chokecherry, Siberian peashrub.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, Russian- olive.	Siberian elm-----	Eastern cottonwood.
23C*: Heimdal-----	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine.	Siberian elm-----	---
Esmond-----	Siberian peashrub, Tatarian honeysuckle.	Ponderosa pine, Russian-olive, eastern redcedar, Rocky Mt. juniper.	Green ash, Siberian elm.	---	---
24*: Fram-----	---	Eastern redcedar, Rocky Mt. juniper, common chokecherry, Siberian peashrub.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, Russian- olive.	Siberian elm-----	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
24*: Emrick-----	---	Eastern redcedar, Rocky Mt. juniper, common chokecherry, Siberian peashrub.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm-----	Eastern cottonwood.
25D*: Esmond-----	Siberian peashrub, Tatarian honeysuckle.	Ponderosa pine, Russian-olive, eastern redcedar, Rocky Mt. juniper.	Green ash, Siberian elm.	---	---
Heimdal-----	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine.	Siberian elm-----	---
25E*: Esmond.					
Heimdal-----	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine.	Siberian elm-----	---
26E*: Esmond.					
Sioux.					
27C*, 28D*: Barnes-----	---	Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine, eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive.	Siberian elm-----	---
Sioux.					
30D*: Barnes.					
Buse.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
31B----- Towner	---	Eastern redcedar, Siberian peashrub, Rocky Mt. juniper, common chokecherry, Tatarian honeysuckle, American plum.	Siberian elm, ponderosa pine, green ash, Russian-olive.	---	---
33C----- Dickey	Lilac, Tatarian honeysuckle, American plum, golden currant.	Green ash, eastern redcedar, Russian-olive.	Siberian elm, ponderosa pine.	---	---
34*, 34B*, 34C*: Embden-----	---	Eastern redcedar, Rocky Mt. juniper, common chokecherry, Siberian peashrub, Tatarian honeysuckle, American plum.	Ponderosa pine, Black Hills spruce.	Siberian elm, American elm, green ash.	Eastern cottonwood.
Heimdal-----	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine.	Siberian elm-----	---
41----- Overly	---	Eastern redcedar, Rocky Mt. juniper, common chokecherry, Siberian peashrub.	Ponderosa pine, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm, American elm, green ash.	Eastern cottonwood.
42----- Gardena	---	Eastern redcedar, common chokecherry, Siberian peashrub, American plum.	Ponderosa pine, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm, American elm, green ash.	Eastern cottonwood.
42B*: Gardena-----	---	Eastern redcedar, common chokecherry, Siberian peashrub, American plum.	Ponderosa pine, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm, American elm, green ash.	Eastern cottonwood.
Eckman-----	---	Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine, eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive.	Siberian elm-----	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
43C*: Eckman-----	---	Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine, eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive.	Siberian elm-----	---
Zell-----	Tatarian honeysuckle, American plum, lilac, Peking cotoneaster.	Ponderosa pine, Russian-olive, green ash, common hackberry, Rocky Mt. juniper, eastern redcedar, Siberian peashrub.	Siberian elm-----	---	---
44----- Glyndon	---	Tall purple willow, northern white-cedar.	Eastern redcedar, white spruce.	Green ash, Russian-olive, golden willow, American elm.	Eastern cottonwood, Siberian elm.
45----- Bearden	---	Eastern redcedar, common chokecherry, Siberian peashrub, Tatarian honeysuckle, American plum.	Ponderosa pine, Black Hills spruce.	Siberian elm, American elm, green ash.	Eastern cottonwood.
46----- Borup	---	Tall purple willow, redosier dogwood, Tatarian honeysuckle, Siberian peashrub.	Russian-olive, eastern redcedar, northern white-cedar.	Green ash, American elm.	Eastern cottonwood, golden willow, Siberian elm.
47----- Fossum	---	Tatarian honeysuckle, Siberian peashrub.	Russian-olive-----	Green ash-----	Eastern cottonwood, Siberian elm.
50B----- Great Bend	Lilac-----	Eastern redcedar, common chokecherry, Siberian peashrub, American plum, silver buffaloberry.	Ponderosa pine, green ash, common hackberry, Russian-olive, Siberian crabapple.	Blue spruce-----	---
52B*: Embden-----	---	Eastern redcedar, Rocky Mt. juniper, common chokecherry, Siberian peashrub, Tatarian honeysuckle, American plum.	Ponderosa pine, Black Hills spruce.	Siberian elm, American elm, green ash.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
52B*: Egeland-----	Silver buffaloberry, Peking cotoneaster, lilac, American plum.	Eastern redcedar, common chokecherry, Siberian peashrub.	Green ash, common hackberry, ponderosa pine, Siberian crabapple, Russian-olive.	---	---
53----- Hecla	---	Common chokecherry, Siberian peashrub, lilac, American plum.	Common hackberry, blue spruce, green ash, Siberian crabapple, eastern redcedar.	Golden willow, ponderosa pine.	Eastern cottonwood.
54B*, 58*: Hecla-----	---	Common chokecherry, Siberian peashrub, lilac, American plum.	Common hackberry, blue spruce, green ash, Siberian crabapple, eastern redcedar.	Golden willow, ponderosa pine.	Eastern cottonwood.
Maddock-----	Tatarian honeysuckle, American plum.	Russian-olive, common chokecherry, Siberian peashrub, eastern redcedar.	Siberian elm, American elm, green ash, ponderosa pine.	---	---
59B*: Maddock-----	Tatarian honeysuckle, American plum.	Russian-olive, common chokecherry, Siberian peashrub, eastern redcedar.	Siberian elm, American elm, green ash, ponderosa pine.	---	---
Hecla-----	---	Common chokecherry, Siberian peashrub, lilac, American plum.	Common hackberry, blue spruce, green ash, Siberian crabapple, eastern redcedar.	Golden willow, ponderosa pine.	Eastern cottonwood.
59D. Maddock					
61, 61B----- Renshaw	---	Eastern redcedar, Russian-olive, Siberian crabapple, silver buffaloberry, Tatarian honeysuckle.	Common hackberry, bur oak.	---	---
63, 63B, 63C----- Brantford	---	Russian-olive, common chokecherry, Siberian peashrub, eastern redcedar, Rocky Mt. juniper, Tatarian honeysuckle, American plum.	Siberian elm, American elm, green ash, ponderosa pine.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
64----- Divide	Siberian peashrub	Ponderosa pine, Black Hills spruce, blue spruce, Russian-olive, eastern redcedar, American plum, common chokecherry.	American elm, green ash.	Siberian elm-----	Eastern cottonwood.
65, 65B----- Vang	---	Russian-olive, common chokecherry, Siberian peashrub, eastern redcedar, Rocky Mt. juniper, Tatarian honeysuckle, American plum.	Siberian elm, American elm, green ash, ponderosa pine.	---	---
66, 67----- Marysland	---	Tatarian honeysuckle, Siberian peashrub, tall purple willow, common chokecherry.	Russian-olive, northern white-cedar, eastern redcedar, Black Hills spruce.	Golden willow, green ash.	Eastern cottonwood, Siberian elm.
68B----- Arvilla	Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Russian-olive, eastern redcedar.	Siberian elm-----	---	---
70B----- Binford	Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, Russian-olive, eastern redcedar.	Siberian elm-----	---	---
71*, 71B*: Svea-----	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, Black Hills spruce, blue spruce, green ash, ponderosa pine, common chokecherry, eastern redcedar.	Siberian elm-----	Eastern cottonwood.
Cresbard-----	Siberian peashrub, silver buffaloberry, American plum, Peking cotoneaster, lilac.	Green ash, Rocky Mt. juniper, Russian-olive, Siberian crabapple, common chokecherry.	Siberian elm, ponderosa pine.	---	---
73*: Larson.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
73*: Cathay-----	Siberian peashrub, American plum.	Ponderosa pine, common chokecherry, eastern redcedar, Rocky Mt. juniper, Russian- olive, American elm.	Siberian elm, green ash.	---	---
74B*: Cavour. Miranda.					
75. Ryan					
78*: LaDelle-----	---	Common chokecherry, Siberian peashrub, American plum, lilac.	Green ash, common hackberry, Siberian crabapple, eastern redcedar.	Golden willow, ponderosa pine, blue spruce.	Eastern cottonwood.
Aberdeen-----	Peking cotoneaster, lilac.	Siberian crabapple, common chokecherry, American plum, silver buffaloberry, Siberian peashrub.	Green ash, common hackberry, ponderosa pine, Russian-olive, eastern redcedar.	---	---
82B----- Darnen	---	Lilac-----	Northern white- cedar, Amur maple, blue spruce, Siberian crabapple.	Eastern white pine, common hackberry, green ash, bur oak, red pine.	American elm.
83----- LaDelle	---	Common chokecherry, Siberian peashrub, American plum, lilac.	Green ash, common hackberry, Siberian crabapple, eastern redcedar.	Golden willow, ponderosa pine, blue spruce.	Eastern cottonwood.
85----- Lamoure	Lilac, American plum.	Eastern redcedar, common chokecherry, Siberian peashrub.	Common hackberry, blue spruce, green ash, ponderosa pine, Siberian crabapple.	Eastern cottonwood, golden willow.	---
86----- LaDelle	---	Common chokecherry, Siberian peashrub, American plum, lilac.	Green ash, common hackberry, Siberian crabapple, eastern redcedar.	Golden willow, ponderosa pine, blue spruce.	Eastern cottonwood.
89----- Grano	---	Eastern redcedar, common chokecherry, Siberian peashrub, American plum.	American elm, ponderosa pine, Black Hills spruce, blue spruce, Russian- olive.	Siberian elm, green ash.	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
90*; Parnell. Lallie. 91C, 91E. Sioux 98C, 98E. Coe 99C. Claire					
101----- Lallie	---	Common chokecherry, eastern redcedar, Siberian peashrub, Tatarian honeysuckle, American plum.	Green ash, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm-----	Eastern cottonwood.
104, 106. Lallie					
107----- Minnewaukan	Siberian peashrub	Eastern redcedar, Rocky Mt. juniper, common chokecherry.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, Russian- olive.	Siberian elm-----	Eastern cottonwood.
109*. Aquents					
110B*: Aastad-----	---	Tatarian honeysuckle, common chokecherry.	Eastern redcedar, Black Hills spruce, ponderosa pine, northern white-cedar, blue spruce, Siberian crabapple.	Siberian elm, green ash, common hackberry.	Eastern cottonwood.
Bottineau-----	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive.	Siberian elm-----	---
112F. Edgeley Variant					
113C, 113D----- Bottineau	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, green ash, ponderosa pine, eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive.	Siberian elm-----	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
119----- Aberdeen	Peking cotoneaster, lilac.	Siberian crabapple, common chokecherry, American plum, silver buffaloberry, Siberian peashrub.	Green ash, common hackberry, ponderosa pine, Russian-olive, eastern redcedar.	---	---
122*: Fram-----	---	Eastern redcedar, Rocky Mt. juniper, common chokecherry, Siberian peashrub.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm-----	Eastern cottonwood.
Cathay-----	Siberian peashrub, American plum.	Ponderosa pine, common chokecherry, eastern redcedar, Rocky Mt. juniper, Russian-olive, American elm.	Siberian elm, green ash.	---	---
123*, 123B*: Emrick-----	---	Eastern redcedar, Rocky Mt. juniper, common chokecherry, Siberian peashrub.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm-----	Eastern cottonwood.
Cathay-----	Siberian peashrub, American plum.	Ponderosa pine, common chokecherry, eastern redcedar, Rocky Mt. juniper, Russian-olive, American elm.	Siberian elm, green ash.	---	---
124C*: Heimdal-----	---	Eastern redcedar, Rocky Mt. juniper, blue spruce, Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, Tatarian honeysuckle.	American elm, green ash, ponderosa pine.	Siberian elm-----	---
Sioux.					
125C*: Heimdal.					
Emrick.					
125F*: Heimdal.					
Esmond.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
126. Fram					
127----- Fram	---	Eastern redcedar, Rocky Mt. juniper, common chokecherry, Siberian peashrub.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm-----	Eastern cottonwood.
129*: Colvin.					
Borup.					
131D. Miranda Variant					
133----- Fordville	Siberian peashrub, Tatarian honeysuckle, silver buffaloberry, Peking cotoneaster, lilac.	Ponderosa pine, green ash, Siberian crabapple, common hackberry, Russian-olive, eastern redcedar.	Siberian elm-----	---	---
134*: Borup-----	---	Tall purple willow, redosier dogwood, Tatarian honeysuckle, Siberian peashrub.	Russian-olive, eastern redcedar, northern white-cedar.	Green ash, American elm.	Eastern cottonwood, golden willow, Siberian elm.
Vallars.					
135*: Miranda.					
Larson.					
137. Stirum					
140B*: Svea-----	---	Siberian peashrub, Tatarian honeysuckle, American plum.	American elm, Black Hills spruce, blue spruce, green ash, ponderosa pine, common chokecherry, eastern redcedar.	Siberian elm-----	Eastern cottonwood.
Buse-----	Lilac, American plum.	Eastern redcedar, common hackberry, Russian-olive, Siberian peashrub, Tatarian honeysuckle.	White spruce, ponderosa pine, Siberian elm, green ash.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
141*: Embsden-----	---	Eastern redcedar, Rocky Mt. juniper, common chokecherry, Siberian peashrub, Tatarian honeysuckle, American plum.	Ponderosa pine, Black Hills spruce.	Siberian elm, American elm, green ash.	Eastern cottonwood.
Letcher-----	Silver buffaloberry, Peking cotoneaster, lilac, American plum.	Eastern redcedar, common chokecherry, Siberian peashrub.	Green ash, common hackberry, ponderosa pine, Siberian crabapple, Russian-olive.	---	---
144*, 144B*: Hamerly-----	---	Eastern redcedar, American plum, common chokecherry, Siberian peashrub.	Ponderosa pine, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm, American elm, green ash.	Eastern cottonwood.
Cresbard-----	Siberian peashrub, silver buffaloberry, American plum, Peking cotoneaster, lilac.	Green ash, Rocky Mt. juniper, Russian-olive, Siberian crabapple, common chokecherry.	Siberian elm, ponderosa pine.	---	---
145. Grano					
146*: Hamerly-----	---	Eastern redcedar, American plum, common chokecherry, Siberian peashrub.	Ponderosa pine, Black Hills spruce, blue spruce, Russian-olive.	Siberian elm, American elm, green ash.	Eastern cottonwood.
Tonka-----	Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, Rocky Mt. juniper, common chokecherry.	American elm, green ash, ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm-----	Eastern cottonwood.
149B----- Maddock	Tatarian honeysuckle, American plum.	Russian-olive, common chokecherry, Siberian peashrub, eastern redcedar.	Siberian elm, American elm, green ash, ponderosa pine.	---	---
150*. Pits					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
3----- Parnell	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, low strength.
4----- Fargo	Severe: wetness.	Severe: shrink-swell, wetness, floods.	Severe: shrink-swell, wetness, floods.	Severe: shrink-swell, wetness, floods.	Severe: low strength, wetness.
5----- Hegne	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, low strength.
7----- Colvin	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: low strength, wetness, floods.
8----- Colvin	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: low strength, wetness, floods.
9----- Rauville	Severe: floods, wetness.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: low strength, wetness, floods.
11*: Svea-----	Moderate: wetness, too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, low strength.	Severe: low strength.
Barnes-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: frost action, low strength.
12B*: Barnes-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Moderate: frost action, low strength.
Svea-----	Moderate: wetness, too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
13C*: Barnes-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Moderate: frost action, low strength.
Buse-----	Slight-----	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
13D*: Barnes-----	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: frost action, slope, low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
13D*: Buse-----	Moderate: slope.	Moderate: shrink-swell, low strength, slope.	Moderate: shrink-swell, slope, low strength.	Severe: slope.	Severe: low strength.
14*: Svea-----	Moderate: wetness, too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, low strength.	Severe: low strength.
Hamerly-----	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.
14B*: Svea-----	Moderate: wetness, too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
Hamerly-----	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: frost action, low strength.
15, 16----- Vallars	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, low strength.
18E----- Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
19----- Tonka	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.
21*: Emrick-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action, low strength.
Heimdal-----	Slight-----	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: frost action, low strength.
22B*: Heimdal-----	Slight-----	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: frost action, low strength.
Emrick-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action, low strength.
23C*: Heimdal-----	Slight-----	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: frost action, low strength.
Esmond-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action, low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
24*: Fram-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.
Emrick-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action, low strength.
25D*: Esmond-----	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action, low strength.
Heimdal-----	Moderate: slope.	Moderate: slope, low strength.	Moderate: slope.	Severe: slope.	Moderate: frost action, low strength, slope.
25E*: Esmond-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Heimdal-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
26E*: Esmond-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sioux-----	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
27C*: Barnes-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Moderate: frost action, low strength.
Sioux-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
28D*: Barnes-----	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: frost action, slope, low strength.
Sioux-----	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
30D*: Barnes-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Buse-----	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
31B----- Towner	Slight-----	Moderate: shrink-swell, low strength.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, low strength.	Moderate: frost action.
33C----- Dickey	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
34*: Embden-----	Severe: outbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.
Heimdal-----	Slight-----	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: frost action, low strength.
34B*, 34C*: Embden-----	Severe: outbanks cave.	Slight-----	Moderate: wetness.	Moderate: slope.	Moderate: frost action.
Heimdal-----	Slight-----	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: frost action, low strength.
41----- Overly	Slight-----	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: frost action, low strength.
42----- Gardena	Moderate: wetness.	Slight-----	Moderate: wetness.	Slight-----	Severe: frost action.
42B*: Gardena-----	Moderate: wetness.	Slight-----	Moderate: wetness.	Moderate: slope.	Severe: frost action.
Eckman-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Severe: frost action.
43C*: Eckman-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Severe: frost action.
Zell-----	Slight-----	Slight-----	Slight-----	Moderate: slope.	Severe: frost action.
44----- Glyndon	Severe: outbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Severe: frost action.
45----- Bearden	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: frost action, low strength.
46----- Borup	Severe: wetness, outbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.
47----- Fossum	Severe: wetness, floods, outbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
50B----- Great Bend	Slight-----	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: frost action, low strength.
52B*: Embden-----	Severe: outbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.
Egeland-----	Severe: outbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
53----- Hecla	Severe: outbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
54B*: Hecla-----	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.
Maddock-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
58*: Hecla-----	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.
Maddock-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
59B*: Maddock-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
Hecla-----	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.
59D----- Maddock	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
61----- Renshaw	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
61B----- Renshaw	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
63----- Brantford	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
63B, 63C----- Brantford	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
64----- Divide	Severe: cutbanks cave.	Moderate: low strength.	Moderate: wetness.	Moderate: low strength.	Severe: low strength.
65----- Vang	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action.
65B----- Vang	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.
66, 67----- Marysland	Severe: wetness, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, low strength.
68B----- Arvilla	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
70B----- Binford	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
71*: Svea-----	Moderate: wetness, too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, low strength.	Severe: low strength.
Cresbard-----	Slight-----	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
71B*: Svea-----	Moderate: wetness, too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
Cresbard-----	Slight-----	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
73*: Larson-----	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength, wetness.	Moderate: shrink-swell, low strength.	Severe: low strength.
Cathay-----	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, low strength.	Severe: low strength.
74B*: Cavour-----	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Miranda-----	Slight-----	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
75----- Ryan	Severe: wetness, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, floods, low strength.
78*: LaDelle-----	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: frost action, low strength, floods.
Aberdeen-----	Slight-----	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
82B----- Darnen	Slight-----	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
83----- LaDelle	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: frost action, low strength, floods.
85----- Lamoure	Severe: floods, wetness.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, low strength, wetness.
86----- LaDelle	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: frost action, low strength, floods.
89----- Grano	Severe: wetness, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, low strength, floods.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
90*: Parnell-----	Severe: floods, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: low strength, wetness, floods.
Lallie-----	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.
91C----- Sioux	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
91E----- Sioux	Severe: slope, cutbanks cave.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
98C----- Coe	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
98E----- Coe	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
99C----- Claire	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
101----- Lallie	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.
104----- Lallie	Severe: wetness, floods.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: low strength, wetness, floods.
106----- Lallie	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.
107----- Minnewaukan	Severe: wetness, floods, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
109*. Aquents					
110B*: Aastad-----	Moderate: too clayey, wetness.	Moderate: shrink-swell, low strength.	Moderate: wetness, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: low strength.
Bottineau-----	Slight-----	Moderate: frost action, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: frost action, shrink-swell, slope.	Severe: low strength.
112F----- Edgeley Variant	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
113C----- Bottineau	Slight-----	Moderate: frost action, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: frost action, shrink-swell, slope.	Severe: low strength.
113D----- Bottineau	Moderate: slope.	Moderate: frost action, shrink-swell, slope.	Moderate: low strength, shrink-swell, slope.	Severe: slope.	Severe: low strength.
119----- Aberdeen	Slight-----	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
122*: Fram-----	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.
Cathay-----	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, low strength.	Severe: low strength.
123*: Emrick-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action, low strength.
Cathay-----	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, low strength.	Severe: low strength.
123B*: Emrick-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action, low strength.
Cathay-----	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
124C*: Heimdal-----	Slight-----	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: frost action, low strength.
Sioux-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
125C*: Heimdal-----	Slight-----	Moderate: low strength.	Moderate: low strength.	Moderate: low strength, slope.	Moderate: frost action, low strength.
Emrick-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action, low strength.
125F*: Heimdal-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Esmond-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
126, 127----- Fram	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
129*: Colvin-----	Severe: wetness.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.
Borup-----	Severe: wetness, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action.
131D----- Miranda Variant	Slight-----	Moderate: shrink-swell, low strength, slope.	Moderate: shrink-swell, low strength, slope.	Severe: slope.	Severe: low strength.
133----- Fordville	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: low strength.
134*: Borup-----	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, frost action.
Vallers-----	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, frost action, low strength.
135*: Miranda-----	Slight-----	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
Larson-----	Moderate: wetness.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength, wetness.	Moderate: shrink-swell, low strength.	Severe: low strength.
137----- Stirum	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
140B*: Svea-----	Moderate: wetness, too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
Buse-----	Slight-----	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, slope, low strength.	Severe: low strength.
141*: Emlden-----	Severe: cutbanks cave.	Slight-----	Moderate: wetness.	Slight-----	Moderate: frost action.
Letcher-----	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Moderate: frost action, low strength.
144*: Hamerly-----	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
144*: Cresbard-----	Slight-----	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
144B*: Hamerly-----	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: frost action, low strength.
Cresbard-----	Slight-----	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
145----- Grano	Severe: wetness, floods.	Severe: floods, shrink-swell, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, shrink-swell, wetness.	Severe: low strength, floods, wetness.
146*: Hamerly-----	Severe: wetness.	Moderate: wetness, shrink-swell, low strength.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.
Tonka-----	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, low strength.
149B----- Maddock	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Slight.
150*. Pits					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
3----- Parnell	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.
4----- Fargo	Severe: percs slowly, wetness.	Slight-----	Severe: too clayey, wetness.	Severe: wetness.	Poor: wetness, too clayey.
5----- Hegne	Severe: wetness, percs slowly.	Slight-----	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, wetness.
7----- Colvin	Severe: percs slowly, wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
8----- Colvin	Severe: percs slowly, wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
9----- Rauville	Severe: floods, wetness, percs slowly.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: wetness.
11*: Svea-----	Severe: percs slowly.	Moderate: slope, seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Barnes-----	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey.
12B*: Barnes-----	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Svea-----	Severe: percs slowly.	Moderate: slope, seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
13C*: Barnes-----	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Buse-----	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
13D*: Barnes-----	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
Buse-----	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
14*, 14B*: Svea-----	Severe: percs slowly.	Moderate: slope, seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Hamerly-----	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
15, 16----- Vallers	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
18E----- Buse	Severe: percs slowly, slope.	Severe: slope.	Moderate: too clayey, slope.	Severe: slope.	Poor: slope.
19----- Tonka	Severe: wetness, floods, percs slowly.	Severe: wetness, floods.	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: too clayey, wetness.
21*: Emrick-----	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Heimdal-----	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
22B*: Heimdal-----	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Emrick-----	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
23C*: Heimdal-----	Slight-----	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Good.
Esmond-----	Slight-----	Severe: slope.	Slight-----	Slight-----	Good.
24*: Fram-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
Emrick-----	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
25D*: Esmond-----	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.	Fair: slope.
Heimdal-----	Moderate: slope.	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Fair: slope.
25E*: Esmond-----	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
Heimdal-----	Severe: slope.	Severe: slope, seepage.	Severe: seepage.	Severe: slope, seepage.	Poor: slope.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
26E*: Esmond-----	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
Sioux-----	Severe: slope.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: slope, seepage.	Poor: slope, small stones, seepage.
27C*: Barnes-----	Severe: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Sioux-----	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: small stones, seepage.
28D*: Barnes-----	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: slope, too clayey.
Sioux-----	Moderate: slope.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: small stones, seepage.
30D*: Barnes-----	Severe: percs slowly, slope.	Severe: slope.	Moderate: too clayey, slope.	Severe: slope..	Poor: slope.
Buse-----	Severe: percs slowly, slope, large stones.	Severe: slope, large stones.	Severe: large stones.	Severe: slope.	Poor: slope, large stones.
31B----- Towner	Severe: percs slowly.	Severe: seepage.	Moderate: wetness.	Severe: seepage.	Fair: too clayey.
33C----- Dickey	Severe: percs slowly.	Severe: slope, seepage.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
34*, 34B*: Embden-----	Severe: wetness.	Severe: seepage.	Severe: seepage, wetness.	Severe: seepage.	Good.
Heimdahl-----	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
34C*: Embden-----	Severe: wetness.	Severe: seepage, slope.	Severe: seepage, wetness.	Severe: seepage.	Good.
Heimdahl-----	Slight-----	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Good.
41----- Overly	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
42----- Gardena	Moderate: wetness.	Moderate: seepage, wetness, slope.	Severe: wetness.	Moderate: wetness.	Good.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
42B*: Gardena-----	Moderate: wetness.	Moderate: seepage, wetness, slope.	Severe: wetness.	Moderate: wetness.	Good.
Eckman-----	Slight-----	Moderate: seepage, slope.	Slight-----	Slight-----	Good.
43C*: Eckman-----	Slight-----	Severe: slope.	Slight-----	Slight-----	Good.
Zell-----	Moderate: percs slowly.	Severe: slope.	Slight-----	Slight-----	Good.
44----- Glyndon	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: too sandy, wetness.
45----- Bearden	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
46----- Borup	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: wetness.
47----- Fossum	Severe: wetness, floods.	Severe: wetness, seepage.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Poor: wetness, too sandy.
50B----- Great Bend	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
52B*: Embden-----	Severe: wetness.	Severe: seepage.	Severe: seepage, wetness.	Severe: seepage.	Good.
Egeland-----	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
53----- Hecla	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness, seepage, too sandy.	Severe: seepage, wetness.	Fair: too sandy, wetness.
54B*: Hecla-----	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness, seepage, too sandy.	Severe: seepage, wetness.	Fair: too sandy, wetness.
Maddock-----	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
58*: Hecla-----	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness, seepage, too sandy.	Severe: seepage, wetness.	Fair: too sandy, wetness.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
58*: Maddock-----	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
59B*: Maddock-----	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
Hecla-----	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness, seepage, too sandy.	Severe: seepage, wetness.	Fair: too sandy, wetness.
59D----- Maddock	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
61, 61B----- Renshaw	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, small stones.
63, 63B----- Brantford	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, small stones, too sandy.
63C----- Brantford	Slight-----	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, small stones, too sandy.
64----- Divide	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: too sandy, small stones, seepage.
65, 65B----- Vang	Slight-----	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
66, 67----- Marysland	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: wetness, too sandy, seepage.
68B----- Arvilla	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
70B----- Binford	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy, seepage, small stones.
71*, 71B*: Svea-----	Severe: percs slowly.	Moderate: slope, seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Cresbard-----	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight-----	Poor: excess sodium.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
73*: Larson-----	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: excess sodium.
Cathay-----	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: excess sodium.
74B*: Cavour-----	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight-----	Poor: excess sodium.
Miranda-----	Severe: percs slowly.	Slight-----	Moderate: too clayey.	Slight-----	Poor: excess sodium.
75----- Ryan	Severe: percs slowly, wetness, floods.	Slight-----	Severe: too clayey, wetness, floods.	Severe: wetness, floods.	Poor: too clayey, excess sodium, wetness.
78*: LaDelle-----	Severe: floods.	Severe: floods.	Severe: wetness, floods.	Severe: floods.	Fair: too clayey.
Aberdeen-----	Severe: percs slowly.	Slight-----	Moderate: too clayey.	Slight-----	Fair: too clayey.
82B----- Darnen	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
83----- LaDelle	Severe: floods.	Severe: floods.	Severe: wetness, floods.	Severe: floods.	Fair: too clayey.
85----- Lamoure	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness.
86----- LaDelle	Severe: floods.	Severe: floods.	Severe: wetness, floods.	Severe: floods.	Fair: too clayey.
89----- Grano	Severe: wetness, percs slowly, floods.	Slight-----	Severe: wetness, too clayey, floods.	Severe: wetness, floods.	Poor: wetness, too clayey.
90*: Parnell-----	Severe: floods, wetness, percs slowly.	Slight-----	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness.
Lallie-----	Severe: wetness, floods, percs slowly.	Slight-----	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: wetness, too clayey.
91C----- Sioux	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: small stones, seepage.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
91E----- Sioux	Severe: slope.	Severe: slope, seepage.	Severe: seepage, too sandy.	Severe: slope, seepage.	Poor: slope, small stones, seepage.
98C----- Coe	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
98E----- Coe	Severe: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage, slope.	Poor: too sandy, seepage, slope.
99C----- Claire	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy.
101----- Lallie	Severe: wetness, floods, percs slowly.	Slight-----	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: wetness, too clayey.
104----- Lallie	Severe: floods, wetness, percs slowly.	Slight-----	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: too clayey, wetness.
106----- Lallie	Severe: wetness, floods, percs slowly.	Slight-----	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: wetness, too clayey.
107----- Minnewaukan	Severe: wetness, floods.	Severe: seepage, wetness.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Poor: wetness, too sandy, seepage.
109*. Aquents					
110B*: Aastad-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey.
Bottineau-----	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
112F----- Edgeley Variant	Severe: slope.	Severe: slope, seepage.	Severe: seepage, slope.	Severe: slope, seepage.	Poor: slope, seepage, small stones.
113C----- Bottineau	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
113D----- Bottineau	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey, slope.
119----- Aberdeen	Severe: percs slowly.	Slight-----	Moderate: too clayey.	Slight-----	Fair: too clayey.
122*: Fram-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
122*: Cathay-----	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: excess sodium.
123*, 123B*: Emrick-----	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Cathay-----	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: excess sodium.
124C*: Heimdal-----	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Sioux-----	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: small stones, seepage.
125C*: Heimdal-----	Slight-----	Severe: seepage.	Severe: seepage.	Slight-----	Good.
Emrick-----	Slight-----	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Good.
125F*: Heimdal-----	Severe: slope.	Severe: slope, seepage.	Severe: seepage.	Severe: slope.	Poor: slope.
Esmond-----	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.	Poor: slope.
126----- Fram	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Fair: wetness.
127----- Fram	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
129*: Colvin-----	Severe: wetness, floods, percs slowly.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
Borup-----	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: wetness.
131D----- Miranda Variant	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----	Poor: excess sodium.
133----- Fordville	Slight-----	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: small stones, too sandy, seepage.
134*: Borup-----	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: wetness.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
134*: Vallers-----	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
135*: Miranda-----	Severe: percs slowly.	Slight-----	Moderate: too clayey.	Slight-----	Poor: excess sodium.
Larson-----	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: excess sodium.
137----- Stirum	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: wetness.
140B*: Svea-----	Severe: percs slowly.	Moderate: slope, seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
Buse-----	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
141*: Emlden-----	Severe: wetness.	Severe: seepage.	Severe: seepage, wetness.	Severe: seepage.	Good.
Letcher-----	Severe: percs slowly, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: excess sodium.
144*, 144B*: Hamerly-----	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Cresbard-----	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight-----	Poor: excess sodium.
145----- Grano	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: too clayey, wetness.
146*: Hamerly-----	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
Tonka-----	Severe: wetness, floods, percs slowly.	Severe: wetness, floods.	Severe: wetness, floods, too clayey.	Severe: wetness, floods.	Poor: too clayey, wetness.
149B----- Maddock	Slight-----	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
150*. Pits					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
3----- Parnell	Poor: wetness, low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
4----- Fargo	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
5----- Hegne	Poor: shrink-swell, wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, wetness.
7, 8----- Colvin	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
9----- Rauville	Poor: low strength, wetness.	Poor: excess fines.	Unsuited: excess fines.	Poor: wetness.
11*: Svea-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Barnes-----	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
12B*: Barnes-----	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Svea-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
13C*: Barnes-----	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Buse-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
13D*: Barnes-----	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Buse-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
14*, 14B*: Svea-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Hamerly-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
15----- Vallers	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, excess salt.
16----- Vallers	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
18E----- Buse	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
19----- Tonka	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
21*: Emrick-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
Heimdal-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
22B*: Heimdal-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
Emrick-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
23C*: Heimdal-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
Esmond-----	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
24*: Fram-----	Fair: low strength, wetness.	Poor: excess fines.	Unsuited: excess fines.	Good.
Emrick-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
25D*: Esmond-----	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Heimdal-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: slope.
25E*: Esmond-----	Fair: slope, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Heimdal-----	Fair: low strength, slope.	Poor: excess fines.	Unsuited: excess fines.	Poor: slope.
26E*: Esmond-----	Fair: slope, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
26E*: Sioux-----	Fair: slope.	Good-----	Good-----	Poor: slope, small stones, area reclaim.
27C*: Barnes-----	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Sioux-----	Good-----	Good-----	Good-----	Poor: small stones, area reclaim.
28D*: Barnes-----	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
Sioux-----	Good-----	Good-----	Good-----	Poor: small stones, area reclaim.
30D*: Barnes-----	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope.
Buse-----	Fair: low strength, large stones, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones, slope.
31B----- Towner	Poor: low strength.	Poor: thin layer.	Unsuited: excess fines.	Fair: too sandy.
33C----- Dickey	Poor: thin layer.	Poor: thin layer, excess fines.	Unsuited: excess fines.	Fair: thin layer.
34*, 34B*, 34C*: Embsden-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
Heimdal-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
41----- Overly	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
42----- Gardena	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
42B*: Gardena-----	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Eckman-----	Fair: low strength.	Unsuited-----	Unsuited-----	Good.
43C*: Eckman-----	Fair: low strength.	Unsuited-----	Unsuited-----	Good.
Zell-----	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
44----- Glyndon	Fair: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
45----- Bearden	Poor: low strength.	Unsuited: excess fines..	Unsuited: excess fines.	Fair: excess salt.
46----- Borup	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
47----- Fossum	Poor: wetness.	Fair: excess fines.	Unsuited: excess fines.	Poor: wetness.
50B----- Great Bend	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
52B*: Embden-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
Egeland-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
53----- Hecla	Fair: wetness, low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy.
54B*: Hecla-----	Fair: wetness, low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Maddock-----	Good-----	Fair: excess fines.	Unsuited: excess fines.	Fair: thin layer.
58*: Hecla-----	Fair: wetness, low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Maddock-----	Good-----	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
59B*: Maddock-----	Good-----	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Hecla-----	Fair: wetness, low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy.
59D----- Maddock	Good-----	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy, slope.
61, 61B----- Renshaw	Good-----	Good-----	Good-----	Poor: thin layer, area reclaim.
63, 63B, 63C----- Brantford	Good-----	Fair: excess fines.	Fair: excess fines.	Poor: area reclaim.
64----- Divide	Good-----	Fair: excess fines.	Fair: excess fines.	Fair: thin layer.
65, 65B----- Vang	Good-----	Fair: excess fines.	Fair: excess fines.	Poor: area reclaim.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
66, 67----- Marysland	Poor: wetness.	Fair: excess fines.	Unsuited: excess fines.	Poor: wetness.
68B----- Arvilla	Good-----	Good-----	Good-----	Poor: area reclaim.
70B----- Binford	Good-----	Fair: excess fines.	Poor: area reclaim.	Poor: area reclaim.
71*, 71B*: Svea-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Cresbard-----	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess sodium.
73*: Larson-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess sodium, excess salt.
Cathay-----	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess sodium.
74B*: Cavour-----	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess salt, excess sodium.
Miranda-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, excess sodium, excess salt.
75----- Ryan	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, excess salt, wetness.
78*: LaDelle-----	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Aberdeen-----	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
82B----- Darnen	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
83----- LaDelle	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
85----- Lamoure	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
86----- LaDelle	Poor: low strength, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
89----- Grano	Poor: wetness, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, wetness.
90*: Parnell-----	Poor: low strength, wetness, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Lallie-----	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, excess salt.
91C----- Sioux	Good-----	Good-----	Good-----	Poor: small stones, area reclaim.
91E----- Sioux	Fair: slope.	Good-----	Good-----	Poor: slope, small stones, area reclaim.
98C----- Coe	Good-----	Fair: excess fines.	Fair: excess fines.	Poor: small stones, thin layer.
98E----- Coe	Fair: slope.	Fair: excess fines.	Fair: excess fines.	Poor: small stones, thin layer, slope.
99C----- Claire	Good-----	Fair: excess fines.	Unsuited-----	Poor: too sandy.
101----- Lallie	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, excess salt.
104----- Lallie	Poor: low strength, wetness, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, excess salt, wetness.
106----- Lallie	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, excess salt.
107----- Minnewaukan	Poor: wetness.	Fair: excess fines.	Unsuited: excess fines.	Poor: too sandy, wetness.
109*, Aquents				
110B*: Aastad-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Bottineau-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
112F----- Edgeley Variant	Poor: low strength.	Unsuited-----	Unsuited-----	Poor: slope.
113C----- Bottineau	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
113D----- Bottineau	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope.
119----- Aberdeen	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, thin layer.
122*: Fram-----	Fair: low strength, wetness.	Poor: excess fines.	Unsuited: excess fines.	Good.
Cathay-----	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess sodium.
123*, 123B*: Emrick-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
Cathay-----	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess sodium.
124C*: Heimdal-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
Sioux-----	Good-----	Good-----	Good-----	Poor: small stones, area reclaim.
125C*: Heimdal-----	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones.
Emrick-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
125F*: Heimdal-----	Fair: low strength, slope.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: large stones, slope.
Esmond-----	Fair: slope, frost action, large stones.	Unsuited-----	Unsuited-----	Poor: slope.
126----- Fram	Fair: low strength, wetness.	Poor: excess fines.	Unsuited: excess fines.	Poor: excess salt.
127----- Fram	Fair: low strength, wetness.	Poor: excess fines.	Unsuited: excess fines.	Good.
129*: Colvin-----	Poor: wetness, floods, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness, excess salt, excess sodium.
Borup-----	Poor: wetness.	Poor: excess fines.	Unsuited: excess fines.	Poor: wetness, excess salt.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
131D----- Miranda Variant	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, excess sodium, excess salt.
133----- Fordville	Good-----	Good-----	Good-----	Fair: area reclaim.
134*: Borup-----	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
Vallers-----	Poor: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
135*: Miranda-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, excess sodium, excess salt.
Larson-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess sodium, excess salt.
137----- Stirum	Poor: wetness.	Poor: excess fines.	Unsuited: excess fines.	Poor: wetness.
140B*: Svea-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Buse-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
141*: Embden-----	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
Letcher-----	Fair: low strength, wetness.	Poor: excess fines.	Unsuited: excess fines.	Poor: excess sodium.
144*, 144B*: Hamerly-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Cresbard-----	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess sodium.
145----- Grano	Poor: low strength, shrink-swell, wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, excess salt, wetness.
146*: Hamerly-----	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Tonka-----	Poor: wetness, low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
149B----- Maddock	Good-----	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
150*. Pits				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
3----- Parnell	Favorable-----	Hard to pack, wetness.	Floods, percs slowly, frost action.	Wetness, slow intake, percs slowly.	Not needed-----	Wetness, percs slowly.
4----- Fargo	Favorable-----	Hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Not needed-----	Wetness, percs slowly.
5----- Hegne	Favorable-----	Wetness, hard to pack.	Percs slowly-----	Wetness, slow intake, percs slowly.	Not needed-----	Wetness, percs slowly.
7----- Colvin	Favorable-----	Wetness, piping.	Floods, frost action.	Wetness, floods.	Not needed-----	Wetness.
8----- Colvin	Favorable-----	Wetness, piping.	Floods, frost action.	Wetness, floods.	Not needed-----	Wetness.
9----- Rauville	Seepage-----	Wetness, hard to pack.	Floods, frost action.	Floods, wetness.	Not needed-----	Wetness.
11*: Svea-----	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Erodes easily.
Barnes-----	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Favorable.
12B*: Barnes-----	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Favorable.
Svea-----	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Erodes easily.
13C*: Barnes-----	Slope-----	Favorable-----	Not needed-----	Slope-----	Favorable-----	Favorable.
Buse-----	Slope-----	Favorable-----	Not needed-----	Slope-----	Favorable-----	Erodes easily.
13D*: Barnes-----	Slope-----	Favorable-----	Not needed-----	Slope-----	Slope-----	Slope.
Buse-----	Slope-----	Favorable-----	Not needed-----	Slope-----	Slope-----	Slope, erodes easily.
14*, 14B*: Svea-----	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Erodes easily.
Hamerly-----	Seepage-----	Wetness-----	Frost action-----	Wetness-----	Wetness-----	Erodes easily.
15----- Vallers	Favorable-----	Wetness, excess salt.	Frost action, excess salt.	Wetness, excess salt.	Not needed-----	Wetness, excess salt.
16----- Vallers	Favorable-----	Wetness-----	Frost action-----	Wetness-----	Not needed-----	Wetness.
18E- Buse	Slope-----	Favorable-----	Not needed-----	Slope-----	Slope-----	Slope, erodes easily.
19----- Tonka	Favorable-----	Hard to pack, wetness.	Frost action, percs slowly, floods.	Wetness, percs slowly, floods.	Not needed-----	Wetness, percs slowly, erodes easily.
21*: Emrick-----	Seepage-----	Piping-----	Not needed-----	Favorable-----	Too sandy-----	Erodes easily.
Heimdal-----	Seepage-----	Piping-----	Not needed-----	Favorable-----	Too sandy-----	Erodes easily.
22B*: Heimdal-----	Seepage-----	Piping-----	Not needed-----	Favorable-----	Too sandy-----	Erodes easily.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
22B*: Emrick-----	Seepage-----	Piping-----	Not needed-----	Favorable-----	Too sandy-----	Erodes easily.
23C*: Heimdal-----	Seepage, slope.	Piping-----	Not needed-----	Slope-----	Too sandy-----	Erodes easily.
Esmond-----	Slope, seepage.	Seepage-----	Not needed-----	Slope-----	Favorable-----	Erodes easily.
24*: Fram-----	Seepage-----	Piping, wetness.	Frost action---	Wetness-----	Not needed-----	Erodes easily.
Emrick-----	Seepage-----	Piping-----	Not needed-----	Favorable-----	Too sandy-----	Erodes easily.
25D*, 25E*: Esmond-----	Slope, seepage.	Seepage-----	Not needed-----	Slope-----	Slope-----	Slope, erodes easily.
Heimdal-----	Seepage, slope.	Piping-----	Not needed-----	Slope-----	Slope, too sandy.	Slope, erodes easily.
26E*: Esmond-----	Slope, seepage.	Seepage-----	Not needed-----	Slope-----	Slope-----	Slope, erodes easily.
Sioux-----	Seepage, slope.	Seepage-----	Not needed-----	Droughty, slope.	Slope, too sandy.	Slope, droughty.
27C*: Barnes-----	Slope-----	Favorable-----	Not needed-----	Slope-----	Favorable-----	Favorable.
Sioux-----	Seepage, slope.	Seepage-----	Not needed-----	Droughty, slope.	Too sandy-----	Droughty.
28D*: Barnes-----	Slope-----	Favorable-----	Not needed-----	Slope-----	Slope-----	Slope.
Sioux-----	Seepage, slope.	Seepage-----	Not needed-----	Droughty, slope.	Slope, too sandy.	Slope, droughty.
30D*: Barnes-----	Slope, seepage.	Favorable-----	Not needed-----	Slope, large stones.	Slope, large stones.	Slope, large stones.
Buse-----	Slope-----	Large stones---	Not needed-----	Large stones, slope.	Slope, large stones.	Slope, large stones.
31B----- Towner	Seepage-----	Favorable-----	Not needed-----	Soil blowing---	Too sandy, soil blowing.	Erodes easily.
33C----- Dickey	Slope, seepage.	Piping-----	Not needed-----	Soil blowing, slope.	Too sandy, soil blowing.	Erodes easily.
34*, 34B*: Embden-----	Seepage-----	Piping-----	Not needed-----	Soil blowing---	Soil blowing---	Favorable.
Heimdal-----	Seepage-----	Piping-----	Not needed-----	Favorable-----	Too sandy-----	Erodes easily.
34C*: Embden-----	Slope, seepage.	Piping-----	Not needed-----	Soil blowing, slope.	Soil blowing---	Favorable.
Heimdal-----	Seepage, slope.	Piping-----	Not needed-----	Slope-----	Too sandy-----	Erodes easily.
41----- Overly	Favorable-----	Favorable-----	Not needed-----	Peres slowly---	Favorable-----	Peres slowly.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
42----- Gardena	Seepage-----	Piping-----	Not needed-----	Favorable-----	Erodes easily	Erodes easily.
42B*: Gardena-----	Seepage-----	Piping-----	Not needed-----	Favorable-----	Erodes easily	Erodes easily.
Eckman-----	Seepage-----	Piping-----	Not needed-----	Favorable-----	Erodes easily	Erodes easily.
43C*: Eckman-----	Slope, seepage.	Piping-----	Not needed-----	Slope-----	Erodes easily	Erodes easily.
Zell-----	Slope, seepage.	Piping-----	Not needed-----	Slope-----	Erodes easily	Erodes easily.
44----- Glyndon	Seepage-----	Seepage, piping.	Frost action---	Wetness-----	Not needed-----	Favorable.
45----- Bearden	Favorable-----	Wetness-----	Peres slowly, frost action, excess salt.	Wetness, peres slowly.	Not needed-----	Peres slowly, erodes easily.
46----- Borup	Seepage-----	Seepage, piping.	Frost action---	Wetness-----	Not needed-----	Wetness.
47----- Fossum	Seepage-----	Seepage-----	Floods-----	Wetness, floods, soil blowing.	Not needed-----	Wetness.
50B----- Great Bend	Slope-----	Piping-----	Not needed-----	Favorable-----	Erodes easily	Erodes easily.
52B*: Embsen-----	Seepage-----	Piping-----	Not needed-----	Soil blowing---	Soil blowing---	Favorable.
Egeland-----	Seepage-----	Piping, seepage.	Not needed-----	Soil blowing---	Soil blowing, too sandy.	Favorable.
53----- Hecla	Seepage-----	Seepage-----	Not needed-----	Fast intake, soil blowing.	Too sandy, soil blowing.	Favorable.
54B*: Hecla-----	Seepage-----	Seepage-----	Not needed-----	Fast intake, soil blowing.	Too sandy, soil blowing.	Favorable.
Maddock-----	Seepage-----	Seepage, piping.	Not needed-----	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
58*: Hecla-----	Seepage-----	Seepage-----	Not needed-----	Fast intake, soil blowing.	Too sandy, soil blowing.	Favorable.
Maddock-----	Seepage-----	Seepage, piping.	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
59B*: Maddock-----	Seepage-----	Seepage, piping.	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Hecla-----	Seepage-----	Seepage-----	Not needed-----	Fast intake, soil blowing.	Too sandy, soil blowing.	Favorable.
59D----- Maddock	Slope, seepage.	Seepage, piping.	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Slope, droughty.
61, 61B----- Renshaw	Seepage-----	Seepage-----	Not needed-----	Droughty-----	Too sandy-----	Droughty.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
63, 63B----- Brantford	Seepage-----	Seepage-----	Not needed-----	Droughty-----	Too sandy-----	Droughty.
63C----- Brantford	Slope, seepage.	Seepage-----	Not needed-----	Droughty, slope.	Too sandy-----	Droughty.
64----- Divide	Seepage-----	Seepage-----	Favorable-----	Wetness-----	Too sandy, wetness.	Favorable.
65, 65B----- Vang	Seepage-----	Seepage-----	Not needed-----	Droughty-----	Too sandy-----	Droughty.
66, 67----- Marysland	Seepage-----	Seepage, wetness.	Frost action---	Wetness-----	Not needed-----	Wetness.
68B----- Arvilla	Seepage-----	Seepage-----	Not needed-----	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
70B----- Binford	Seepage-----	Piping, seepage.	Not needed-----	Droughty, seepage, soil blowing.	Too sandy, soil blowing.	Droughty.
71*, 71B*: Svea-----	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Erodes easily.
Cresbard-----	Favorable-----	Hard to pack---	Not needed-----	Percs slowly, excess sodium.	Percs slowly---	Percs slowly.
73*: Larson-----	Seepage-----	Piping-----	Excess salt, percs slowly, excess sodium.	Excess salt, percs slowly, excess sodium.	Percs slowly---	Excess salt, percs slowly, excess sodium.
Cathay-----	Favorable-----	Piping-----	Not needed-----	Excess sodium, percs slowly.	Percs slowly---	Excess sodium, percs slowly.
74B*: Cavour-----	Favorable-----	Hard to pack, piping.	Not needed-----	Percs slowly, erodes easily, excess sodium.	Percs slowly---	Excess sodium, erodes easily, excess salt.
Miranda-----	Favorable-----	Piping, excess salt.	Not needed-----	Excess salt, percs slowly, excess sodium.	Not needed-----	Excess sodium, percs slowly, excess salt.
75----- Ryan	Favorable-----	Hard to pack, wetness, piping.	Excess salt, percs slowly, floods.	Wetness, slow intake, percs slowly.	Not needed-----	Wetness, excess salt, excess sodium.
78*: LaDelle-----	Seepage-----	Favorable-----	Not needed-----	Floods-----	Not needed-----	Favorable.
Aberdeen-----	Favorable-----	Hard to pack---	Not needed-----	Percs slowly, excess sodium.	Not needed-----	Excess sodium, erodes easily.
82B----- Darnen	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Erodes easily.
83----- LaDelle	Seepage-----	Favorable-----	Not needed-----	Floods-----	Not needed-----	Favorable.
85----- Lamoure	Seepage-----	Hard to pack, wetness.	Floods, frost action.	Wetness, floods.	Not needed-----	Wetness.
86----- LaDelle	Seepage-----	Favorable-----	Not needed-----	Floods-----	Not needed-----	Favorable.
89----- Grano	Favorable-----	Hard to pack, wetness.	Percs slowly, frost action.	Wetness, slow intake, percs slowly.	Not needed-----	Wetness, percs slowly.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
90*: Parnell-----	Favorable-----	Hard to pack, wetness.	Percs slowly, floods, frost action.	Wetness, slow intake, floods.	Not needed-----	Wetness, percs slowly.
Lallie-----	Favorable-----	Hard to pack, wetness, excess salt.	Floods, frost action, excess salt.	Wetness, percs slowly, excess salt.	Not needed-----	Wetness, percs slowly, excess salt.
91C----- Sioux	Seepage-----	Seepage-----	Not needed-----	Droughty-----	Too sandy-----	Droughty.
91E----- Sioux	Seepage, slope.	Seepage-----	Not needed-----	Droughty, slope.	Slope, too sandy.	Slope, droughty.
98C----- Coe	Seepage-----	Seepage-----	Not needed-----	Droughty-----	Too sandy-----	Droughty.
98E----- Coe	Slope, seepage.	Seepage-----	Not needed-----	Droughty, slope.	Slope, too sandy.	Slope, droughty.
99C----- Claire	Seepage-----	Seepage-----	Not needed-----	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
101----- Lallie	Favorable-----	Hard to pack, wetness, excess salt.	Floods, frost action, excess salt.	Wetness, percs slowly, excess salt.	Not needed-----	Wetness, percs slowly, excess salt.
104----- Lallie	Favorable-----	Hard to pack, wetness, excess salt.	Percs slowly, floods, frost action.	Wetness, slow intake, percs slowly.	Not needed-----	Wetness, excess salt, erodes easily.
106----- Lallie	Favorable-----	Hard to pack, wetness, excess salt.	Floods, frost action, excess salt.	Wetness, percs slowly, excess salt.	Not needed-----	Wetness, percs slowly, excess salt.
107----- Minnewaukan	Seepage-----	Seepage, wetness.	Floods-----	Fast intake, wetness, soil blowing.	Not needed-----	Wetness.
109*. Aquents						
110B*: Aastad-----	Favorable-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Favorable.
Bottineau-----	Favorable-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Favorable.
112F----- Edgeley Variant	Seepage, slope.	Seepage-----	Not needed-----	Slope-----	Slope-----	Slope.
113C----- Bottineau	Slope-----	Favorable-----	Not needed-----	Slope-----	Favorable-----	Favorable.
113D----- Bottineau	Slope-----	Favorable-----	Not needed-----	Slope-----	Slope-----	Slope.
119----- Aberdeen	Favorable-----	Hard to pack---	Not needed-----	Percs slowly, excess sodium.	Not needed-----	Excess sodium, erodes easily.
122*: Fram-----	Seepage-----	Piping, wetness.	Frost action---	Wetness-----	Not needed-----	Erodes easily.
Cathay-----	Favorable-----	Piping-----	Not needed-----	Excess sodium, percs slowly.	Percs slowly---	Excess sodium, percs slowly.
123*, 123B*: Emrick-----	Seepage-----	Piping-----	Not needed-----	Favorable-----	Too sandy-----	Erodes easily.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
123*, 123B*: Cathay-----	Favorable-----	Piping-----	Not needed-----	Excess sodium, percs slowly.	Peres slowly----	Excess sodium, percs slowly.
124C*: Heimdal-----	Seepage, slope.	Piping-----	Not needed-----	Slope-----	Too sandy-----	Erodes easily.
Sioux-----	Seepage, slope.	Seepage-----	Not needed-----	Droughty, slope.	Too sandy-----	Droughty.
125C*: Heimdal-----	Seepage-----	Piping-----	Not needed-----	Favorable-----	Favorable-----	Favorable.
Emrick-----	Seepage-----	Piping-----	Not needed-----	Favorable-----	Favorable-----	Erodes easily.
125F*: Heimdal-----	Slope, seepage.	Piping-----	Not needed-----	Slope-----	Slope-----	Slope.
Esmond-----	Slope, seepage.	Seepage-----	Not needed-----	Slope-----	Slope-----	Slope, erodes easily.
126----- Fram	Seepage-----	Excess salt, wetness.	Frost action, excess salt.	Wetness, excess salt.	Not needed-----	Excess salt, erodes easily.
127----- Fram	Seepage-----	Piping, wetness.	Frost action----	Wetness-----	Not needed-----	Erodes easily.
129*: Colvin-----	Seepage-----	Wetness, piping.	Floods, frost action, excess salt.	Floods, wetness, excess sodium	Not needed-----	Wetness, excess salt, excess sodium.
Borup-----	Seepage-----	Seepage, piping.	Frost action----	Wetness, excess salt.	Not needed-----	Wetness, excess salt.
131D----- Miranda Variant	Slope-----	Piping, excess salt.	Not needed-----	Slope, percs slowly, excess sodium.	Not needed-----	Excess sodium, percs slowly, excess salt.
133----- Fordville	Seepage-----	Seepage-----	Not needed-----	Favorable-----	Too sandy-----	Favorable.
134*: Borup-----	Seepage-----	Seepage, piping.	Frost action----	Wetness-----	Not needed-----	Wetness.
Vallers-----	Favorable-----	Wetness-----	Frost action----	Wetness-----	Wetness-----	Wetness.
135*: Miranda-----	Favorable-----	Piping, excess salt.	Not needed-----	Excess salt, percs slowly, excess sodium.	Not needed-----	Excess sodium, percs slowly, excess salt.
Larson-----	Seepage-----	Piping-----	Excess salt, percs slowly, excess sodium.	Excess salt, percs slowly, excess sodium.	Peres slowly----	Excess salt, percs slowly, excess sodium.
137----- Stirum	Seepage-----	Piping, wetness.	Excess salt, floods.	Wetness, fast intake, soil blowing.	Not needed-----	Wetness.
140B*: Svea-----	Seepage-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Erodes easily.
Buse-----	Favorable-----	Favorable-----	Not needed-----	Favorable-----	Favorable-----	Erodes easily.
141*: Embden-----	Seepage-----	Piping-----	Not needed-----	Soil blowing----	Soil blowing----	Favorable.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
141*: Letcher-----	Seepage-----	Piping-----	Not needed-----	Percs slowly, excess sodium, soil blowing.	Too sandy, soil blowing, percs slowly.	Excess sodium, percs slowly.
144*, 144B*: Hamerly-----	Seepage-----	Wetness-----	Frost action-----	Wetness-----	Wetness-----	Erodes easily.
Cresbard-----	Favorable-----	Hard to pack-----	Not needed-----	Percs slowly, excess sodium.	Percs slowly-----	Percs slowly.
145----- Grano	Favorable-----	Hard to pack, wetness, excess salt.	Percs slowly, floods, frost action.	Wetness, slow intake, percs slowly.	Not needed-----	Wetness, excess salt, erodes easily.
146*: Hamerly-----	Seepage-----	Wetness-----	Frost action-----	Wetness-----	Not needed-----	Erodes easily.
Tonka-----	Favorable-----	Hard to pack, wetness.	Frost action, percs slowly, floods.	Wetness, percs slowly, floods.	Not needed-----	Wetness, percs slowly, erodes easily.
149B----- Maddock	Seepage-----	Seepage, piping.	Not needed-----	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
150*. Pits						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
3----- Parnell	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.
4----- Fargo	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
5----- Hegne	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
7----- Colvin	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: floods, wetness.
8----- Colvin	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: floods, wetness.
9----- Rauville	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.
11*: Svea-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Barnes-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Slight.
12B*: Barnes-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Slight.
Svea-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
13C*: Barnes-----	Moderate: percs slowly.	Slight-----	Severe: slope.	Slight-----	Slight.
Buse-----	Moderate: percs slowly.	Slight-----	Severe: slope.	Slight-----	Slight.
13D*: Barnes-----	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Buse-----	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
14*, 14B*: Svea-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Hamerly-----	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: slope, wetness.	Slight-----	Moderate: wetness.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
15----- Vallers	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: excess salt.
16----- Vallers	Severe: wetness, floods.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
18E----- Buse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
19----- Tonka	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
21*: Emrick-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Heimdal-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
22B*: Heimdal-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Emrick-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
23C*: Heimdal-----	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
Esmond-----	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
24*: Fram-----	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight-----	Slight.
Emrick-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
25D*: Esmond-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Heimdal-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
25E*: Esmond-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Heimdal-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
26E*: Esmond-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Sioux-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: small stones, droughty, slope.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
27C*: Barnes-----	Moderate: percs slowly.	Slight-----	Severe: slope.	Slight-----	Slight.
Sioux-----	Slight-----	Slight-----	Severe: slope.	Slight-----	Severe: small stones, droughty.
28D*: Barnes-----	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.
Sioux-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight-----	Severe: small stones, droughty.
30D*: Barnes-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope, large stones.
Buse-----	Severe: slope, large stones.	Severe: slope, large stones.	Severe: large stones, slope.	Severe: large stones.	Severe: large stones, slope.
31B----- Towner	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
33C----- Dickey	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
34*, 34B*: Embden-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Heimdal-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
34C*: Embden-----	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
Heimdal-----	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
41----- Overly	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Moderate: too clayey.
42----- Gardena	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
42B*: Gardena-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Eckman-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
43C*: Eckman-----	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
Zell-----	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
44----- Glyndon	Slight-----	Slight-----	Slight-----	Slight-----	Slight.
45----- Bearden	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness, percs slowly.	Slight-----	Moderate: wetness.
46----- Borup	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
47----- Fossum	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
50B----- Great Bend	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Slight.
52B*: Embsen-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Egeland-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
53----- Hecla	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
54B*: Hecla-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
Maddock-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
58*: Hecla-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
Maddock-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
59B*: Maddock-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
Hecla-----	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
59D----- Maddock	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.	Moderate: too sandy, slope.
61, 61B----- Renshaw	Slight-----	Slight-----	Moderate: slope.	Slight-----	Severe: small stones, droughty.
63, 63B----- Brantford	Slight-----	Slight-----	Moderate: slope, small stones.	Slight-----	Moderate: small stones.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
63C----- Brantford	Slight-----	Slight-----	Severe: slope.	Slight-----	Moderate: small stones.
64----- Divide	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
65, 65B----- Vang	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
66, 67----- Marysland	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
68B----- Arvilla	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
70B----- Binford	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
71*, 71B*: Svea-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Cresbard-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Severe: excess sodium.
73*: Larson-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Severe: excess sodium, excess salt.
Cathay-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Severe: excess sodium.
74B*: Cavour-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Severe: excess sodium, excess salt.
Miranda-----	Moderate: percs slowly.	Slight-----	Moderate: percs slowly.	Slight-----	Severe: excess sodium, excess salt.
75----- Ryan	Severe: floods, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: wetness, excess salt, excess sodium.
78*: LaDelle-----	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight-----	Moderate: floods.
Aberdeen-----	Moderate: percs slowly.	Slight-----	Moderate: percs slowly.	Slight-----	Slight.
82B----- Darnen	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
83----- LaDelle	Severe: floods.	Moderate: floods.	Slight-----	Slight-----	Moderate: floods.
85----- Lamoure	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
86----- LaDelle	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
89----- Grano	Severe: floods, wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey, floods.
90*: Parnell-----	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.	Severe: wetness.	Severe: floods, wetness.
Lallie-----	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
91C----- Sioux	Slight-----	Slight-----	Severe: small stones.	Slight-----	Severe: small stones, droughty.
91E----- Sioux	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: small stones, droughty, slope.
98C----- Coe	Moderate: small stones.	Moderate: small stones.	Severe: small stones.		Severe: small stones.
98E----- Coe	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: small stones, slope.	Severe: small stones, slope.
99C----- Claire	Moderate: too sandy.	Moderate: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
101, 104, 106----- Lallie	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
107----- Minnewaukan	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
109*. Aquents					
110B*: Aastad-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Slight.
Bottineau-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Slight.
112F----- Edgeley Variant	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
113C----- Bottineau	Moderate: percs slowly.	Slight-----	Severe: slope.	Slight-----	Slight.
113D----- Bottineau	Moderate: slope, percs slowly.	Moderate: slope.	Severe: slope.	Slight-----	Moderate: slope.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
119----- Aberdeen	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey.
122*: Fram-----	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight-----	Slight.
Cathay-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Severe: excess sodium.
123*, 123B*: Emrick-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Cathay-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Severe: excess sodium.
124C*: Heimdal-----	Slight-----	Slight-----	Severe: slope.	Slight-----	Slight.
Sioux-----	Slight-----	Slight-----	Severe: slope.	Slight-----	Severe: small stones, droughty.
125C*: Heimdal-----	Slight-----	Slight-----	Moderate: large stones, slope.	Slight-----	Slight.
Emrick-----	Slight-----	Slight-----	Moderate: large stones, slope.	Slight-----	Slight.
125F*: Heimdal-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Esmond-----	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
126----- Fram	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight-----	Severe: excess salt.
127----- Fram	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight-----	Slight.
129*: Colvin-----	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: excess salt, floods, wetness.
Borup-----	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, excess salt.
131D----- Miranda Variant	Moderate: percs slowly, slope.	Moderate: slope.	Severe: slope.	Slight-----	Severe: excess sodium, excess salt.
133----- Fordville	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
134*: Borup-----	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Vallers-----	Severe: wetness, floods.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
135*: Miranda-----	Moderate: percs slowly.	Slight-----	Moderate: percs slowly.	Slight-----	Severe: excess sodium, excess salt.
Larson-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Severe: excess sodium, excess salt.
137----- Stirum	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
140B*: Svea-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Buse-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Slight.
141*: Embsen-----	Slight-----	Slight-----	Moderate: slope.	Slight-----	Slight.
Letcher-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Severe: excess sodium.
144*, 144B*: Hamerly-----	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: slope, wetness.	Slight-----	Moderate: wetness.
Cresbard-----	Moderate: percs slowly.	Slight-----	Moderate: slope, percs slowly.	Slight-----	Severe: excess sodium.
145----- Grano	Severe: floods, wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey, floods.	Severe: too clayey, wetness, excess salt.
146*: Hamerly-----	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.	Slight-----	Moderate: wetness.
Tonka-----	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness.	Severe: wetness, floods.
149B----- Maddock	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
150*. Pits					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
3----- Parnell	Poor	Poor	Poor	Poor	Good	Good	Poor	Good	Poor.
4----- Fargo	Good	Good	Fair	Poor	Good	Good	Fair	Good	Poor.
5----- Hegne	Poor	Fair	Fair	Poor	Poor	Good	Fair	Fair	Poor.
7----- Colvin	Poor	Fair	Fair	Fair	Good	Good	Poor	Good	Fair.
8----- Colvin	Very poor	Poor	Poor	Poor	Good	Good	Poor	Good	Poor.
9----- Rauville	Very poor	Poor	Poor	Poor	Good	Good	Very poor	Good	Poor.
11*: Svea-----	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Barnes-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
12B*: Barnes-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Svea-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
13C*: Barnes-----	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Buse-----	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
13D*: Barnes-----	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Buse-----	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
14*: Svea-----	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Hamerly-----	Good	Good	Good	Fair	Fair	Poor	Good	Poor	Fair.
14B*: Svea-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Hamerly-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
15----- Vallers	Fair	Fair	Very poor	Fair	Good	Good	Fair	Good	Poor.
16----- Vallers	Fair	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
18E----- Buse	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
19----- Tonka	Good	Good	Fair	Poor	Good	Good	Good	Good	Poor.
21*: Emrick-----	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
21*: Heimdal-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
22B*: Heimdal-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Emrick-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
23C*: Heimdal-----	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Esmond-----	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
24*: Fram-----	Good	Good	Good	Fair	Fair	Poor	Good	Poor	Fair.
Emrick-----	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
25D*, 25E*: Esmond-----	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Heimdal-----	Poor	Fair	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
26E*: Esmond-----	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Sioux-----	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
27C*: Barnes-----	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Sioux-----	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
28D*: Barnes-----	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Sioux-----	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
30D*: Barnes-----	Poor	Poor	Good	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Buse-----	Very poor	Very poor	Good	Fair	Very poor	Very poor	Very poor	Very poor	Good.
31B----- Towner	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
33C----- Dickey	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
34*: Embden-----	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
Heimdal-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
34B*: Embden-----	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Heimdal-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
34C*: Embden-----	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Heimdal-----	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
41----- Overly	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
42----- Gardena	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
42B*: Gardena-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Eckman-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
43C*: Eckman-----	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Zell-----	Poor	Fair	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
44----- Glyndon	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
45----- Bearden	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
46----- Borup	Fair	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
47----- Fossum	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
50B----- Great Bend	Good	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
52B*: Embden-----	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Egeland-----	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
53----- Hecla	Poor	Fair	Good	Fair	Fair	Very poor	Fair	Poor	Good.
54B*: Hecla-----	Poor	Fair	Good	Fair	Fair	Very poor	Fair	Poor	Good.
Maddock-----	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
58*: Hecla-----	Poor	Fair	Good	Fair	Fair	Very poor	Fair	Poor	Good.
Maddock-----	Fair	Good	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
59B*: Maddock-----	Fair	Good	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
Hecla-----	Poor	Fair	Good	Fair	Fair	Very poor	Fair	Poor	Good.
59D----- Maddock	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
61, 61B----- Renshaw	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
63----- Brantford	Fair	Fair	Good	Poor	Poor	Poor	Fair	Very poor	Fair.
63B, 63C----- Brantford	Fair	Fair	Good	Poor	Poor	Very poor	Fair	Very poor	Fair.
64----- Divide	Fair	Fair	Good	Fair	Fair	Very poor	Fair	Poor	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
65----- Vang	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
65B----- Vang	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
66, 67----- Marysland	Good	Good	Fair	Fair	Good	Good	Fair	Poor	Fair.
68B----- Arvilla	Fair	Good	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
70B----- Binford	Fair	Good	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
71*: Svea-----	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
Cresbard-----	Fair	Good	Good	Poor	Poor	Very poor	Good	Very poor	Fair.
71B*: Svea-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Cresbard-----	Fair	Good	Good	Poor	Poor	Very poor	Good	Very poor	Fair.
73*: Larson-----	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	Poor.
Cathay-----	Fair	Good	Good	Poor	Poor	Poor	Fair	Poor	Fair.
74B*: Cavour-----	Poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Miranda-----	Very poor	Very poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Very poor.
75----- Ryan	Poor	Poor	Poor	Very poor	Poor	Good	Poor	Fair	Very poor.
78*: LaDelle-----	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
Aberdeen-----	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Very poor	Poor.
82B----- Darnen	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
83----- LaDelle	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
85----- Lamoure	Good	Good	Good	Fair	Good	Fair	Good	Fair	Fair.
86----- LaDelle	Poor	Good	Fair	Good	Poor	Poor	Poor	Poor	Fair.
89----- Grano	Fair	Fair	Fair	Poor	Good	Good	Fair	Good	Poor.
90*: Parnell-----	Very poor	Very poor	Very poor	Poor	Good	Good	Very poor	Good	Very poor.
Lallie-----	Very poor	Very poor	Fair	Poor	Good	Good	Very poor	Good	Very poor.
91C----- Sioux	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
91E----- Sioux	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
98C----- Coe	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Fair.
98E----- Coe	Very poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Fair.
99C----- Claire	Poor	Fair	Fair	Good	Very poor	Very poor	Fair	Very poor	Very poor.
101----- Lallie	Fair	Fair	Fair	Poor	Poor	Good	Fair	Fair	Poor.
104----- Lallie	Poor	Poor	Poor	Very poor	Poor	Good	Poor	Fair	Very poor.
106----- Lallie	Very poor	Fair	Fair	Poor	Poor	Good	Poor	Fair	Poor.
107----- Minnewaukan	Poor	Poor	Fair	Fair	Fair	Very poor	Poor	Poor	Fair.
109*, Aquents									
110B*: Aastad-----	Good	Good	Good	Fair	Poor	Very poor	Good	Poor	Fair.
Bottineau-----	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
112F----- Edgeley Variant	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
113C, 113D----- Bottineau	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
119----- Aberdeen	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Very poor	Poor.
122*: Fram-----	Good	Good	Good	Fair	Fair	Poor	Good	Poor	Fair.
Cathay-----	Fair	Good	Good	Poor	Poor	Poor	Fair	Poor	Fair.
123*: Emrick-----	Good	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
Cathay-----	Fair	Good	Good	Poor	Poor	Poor	Fair	Poor	Fair.
123B*: Emrick-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Cathay-----	Fair	Good	Good	Poor	Poor	Very poor	Fair	Very poor	Fair.
124C*: Heimdal-----	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Sioux-----	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
125C*: Heimdal-----	Poor	Poor	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
Emrick-----	Poor	Poor	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
125F*: Heimdal-----	Very poor	Poor	Good	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Esmond-----	Poor	Poor	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
126----- Fram	Fair	Fair	Poor	Poor	Fair	Fair	Fair	Fair	Fair.
127----- Fram	Good	Good	Good	Fair	Fair	Poor	Good	Poor	Fair.
129*: Colvin-----	Poor	Fair	Poor	Fair	Good	Good	Poor	Good	Poor.
Borup-----	Fair	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
131D----- Miranda Variant	Very poor	Very poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Very poor.
133----- Fordville	Fair	Good	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
134*: Borup-----	Fair	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
Vallers-----	Fair	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
135*: Miranda-----	Very poor	Very poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Very poor.
Larson-----	Poor	Poor	Poor	Very poor	Poor	Very poor	Poor	Very poor	Very poor.
137----- Stirum	Poor	Poor	Very poor	Fair	Good	Fair	Poor	Fair	Poor.
140B*: Svea-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Buse-----	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
141*: Embden-----	Fair	Good	Good	Fair	Poor	Poor	Good	Poor	Fair.
Letcher-----	Fair	Good	Good	Very poor	Poor	Poor	Fair	Poor	Poor.
144*: Hamerly-----	Good	Good	Good	Fair	Fair	Poor	Good	Poor	Fair.
Cresbard-----	Fair	Good	Good	Poor	Poor	Very poor	Good	Very poor	Fair.
144B*: Hamerly-----	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Cresbard-----	Fair	Good	Good	Poor	Poor	Very poor	Good	Very poor	Fair.
145----- Grano	Poor	Poor	Very poor	Very poor	Poor	Good	Poor	Fair	Very poor.
146*: Hamerly-----	Good	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Tonka-----	Good	Good	Fair	Poor	Good	Good	Good	Good	Poor.
149B----- Maddock	Fair	Good	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
150*. Pits									

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
3----- Parnell	0-14 14-60	Silty clay loam Clay loam, silty clay loam, silty clay.	CL, CH CL, CH	A-7 A-7	0 0	100 100	100 95-100	95-100 90-100	85-95 70-95	40-60 40-80	15-30 20-50
4----- Fargo	0-9 9-30 30-60	Silty clay loam Silty clay, clay Silty clay, clay	CL CH CH	A-6, A-7 A-7 A-7	0 0 0	100 100 100	100 100 100	95-100 95-100 95-100	85-95 85-100 85-100	25-50 50-75 50-75	11-35 25-45 25-45
5----- Hegne	0-10 10-24 24-60	Silty clay----- Silty clay, clay Clay, silty clay	CH CH CH	A-7 A-7 A-7	0 0 0	100 100 100	100 100 100	95-100 95-100 95-100	90-98 95-98 95-100	50-70 50-70 50-70	25-40 25-40 25-45
7----- Colvin	0-12 12-60	Silt loam----- Silt loam, silty clay loam, loam.	CL CL	A-6 A-6, A-7	0 0	100 100	100 100	90-100 90-100	80-95 80-95	25-40 25-50	10-20 10-30
8----- Colvin	0-12 12-60	Silt loam----- Silt loam, silty clay loam, loam	CL CL	A-6 A-6, A-7	0 0	100 100	100 100	90-100 90-100	80-95 80-95	25-40 25-50	10-20 10-30
9----- Rauville	0-20 20-60	Silt loam----- Silty clay loam, silt loam.	CL, ML CL, CH, MH	A-6, A-7 A-6, A-7	0 0	100 100	100 100	90-100 90-100	80-100 85-100	35-50 35-60	10-25 15-28
11*: Svea-----	0-12 12-22 22-60	Loam----- Loam, clay loam Loam, clay loam	CL, CL-ML CL, CL-ML CL, CL-ML	A-4, A-6 A-4, A-6, A-7 A-4, A-6, A-7	0-5 0-5 0-5	95-100 95-100 95-100	85-100 85-100 85-100	80-95 80-95 80-95	60-90 60-90 60-80	20-40 20-45 20-50	5-25 5-25 5-30
Barnes-----	0-8 8-18 18-60	Loam----- Loam, clay loam Loam, clay loam	CL, CL-ML CL, CL-ML CL, CL-ML	A-4, A-6 A-4, A-6 A-4, A-6	0-5 0-5 0-5	95-100 95-100 95-100	90-100 90-100 90-100	85-100 80-95 80-95	60-90 55-80 55-80	20-40 25-40 25-40	5-15 5-15 5-15
12B*: Barnes-----	0-8 8-18 18-60	Loam----- Loam, clay loam Loam, clay loam	CL, CL-ML CL, CL-ML CL, CL-ML	A-4, A-6 A-4, A-6 A-4, A-6	0-5 0-5 0-5	95-100 95-100 95-100	90-100 90-100 90-100	85-100 80-95 80-95	60-90 55-80 55-80	20-40 25-40 25-40	5-15 5-15 5-15
Svea-----	0-12 12-22 22-60	Loam----- Loam, clay loam Loam, clay loam	CL, CL-ML CL, CL-ML CL, CL-ML	A-4, A-6 A-4, A-6 A-4, A-6, A-7	0-5 0-5 0-5	95-100 95-100 95-100	85-100 85-100 85-100	80-95 80-95 80-95	60-90 60-90 60-80	20-40 20-45 20-50	5-25 5-25 5-30
13C*, 13D*: Barnes-----	0-8 8-18 18-60	Loam----- Loam, clay loam Loam, clay loam	CL, CL-ML CL, CL-ML CL, CL-ML	A-4, A-6 A-4, A-6 A-4, A-6	0-5 0-5 0-5	95-100 95-100 95-100	90-100 90-100 90-100	85-100 80-95 80-95	60-90 55-80 55-80	20-40 25-40 25-40	5-15 5-15 5-15
Buse-----	0-8 8-60	Loam----- Loam, clay loam	ML, CL, CL-ML	A-4, A-6 A-4, A-6	0 0	90-100 90-100	85-95 85-95	70-90 70-90	55-80 60-80	20-40 25-40	3-20 5-20

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
14*, 14B*: Svea-----	0-12	Loam-----	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	12-22	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-90	20-45	5-25
	22-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-80	20-50	5-30
Hamerly-----	0-9	Loam-----	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-25
	9-22	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	22-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
15----- Vallers	0-9	Loam-----	OL, ML	A-4	0	95-100	90-100	80-90	65-80	25-40	3-10
	9-22	Clay loam, loam	CL	A-6	0	95-100	90-100	90-95	70-80	30-40	10-20
	22-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	95-100	90-100	85-95	60-75	20-40	5-20
16----- Vallers	0-9	Loam-----	OL, ML	A-4	0	95-100	90-100	80-90	65-80	30-40	4-10
	9-22	Clay loam, loam	CL	A-6	0	95-100	90-97	90-95	70-80	30-40	11-20
	22-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	95-100	90-97	85-95	60-75	20-40	5-20
18E----- Buse	0-8	Loam-----	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	8-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-20
19----- Tonka	0-22	Silt loam-----	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-40	5-25
	22-38	Silty clay loam, clay loam, silty clay.	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	15-35
	38-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-3	100	95-100	90-100	70-90	20-50	10-30
21*: Emrick-----	0-16	Loam-----	ML, CL-ML, CL	A-4, A-6	0-1	95-100	95-100	85-100	60-90	20-40	NP-15
	16-34	Loam-----	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	34-60	Loam, sandy loam, fine sand.	ML, SM	A-4, A-2	0-5	95-100	95-100	65-100	30-90	20-40	NP-10
Heimdal-----	0-8	Loam-----	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-19	Loam-----	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	19-60	Loam, silt loam, sandy clay loam.	ML, SM	A-4, A-2	0-5	95-100	95-100	65-100	30-90	20-40	NP-10
22B*: Heimdal-----	0-8	Loam-----	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-19	Loam-----	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	19-60	Loam, silt loam, sandy clay loam.	ML, SM	A-4, A-2	0-5	95-100	95-100	65-100	30-90	20-40	NP-10
Emrick-----	0-16	Loam-----	ML, CL-ML, CL	A-4, A-6	0-1	95-100	95-100	85-100	60-90	20-40	NP-15
	16-34	Loam-----	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	34-60	Loam, sandy loam, fine sand.	ML, SM	A-4, A-2	0-5	95-100	95-100	65-100	30-90	20-40	NP-10

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches Pct	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>					4	10	40	200		
23C*:											
Heimdal-----	0-8	Loam-----	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-19	Loam-----	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	19-60	Loam, silt loam, sandy clay loam.	ML, SM	A-4, A-2	0-5	95-100	95-100	65-100	30-90	20-40	NP-10
Esmond-----	0-9	Loam-----	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	9-60	Loam, fine sandy loam, silt loam.	ML, SM	A-4	0-5	95-100	95-100	70-100	40-90	20-40	NP-10
24*:											
Fram-----	0-13	Loam-----	ML, SM	A-4	0-1	90-100	70-100	55-75	40-70	20-40	NP-10
	13-60	Sandy loam, fine sandy loam, loam.	SM, SC, SM-SC	A-2, A-4	0-1	90-100	70-95	45-70	25-50	<30	NP-10
Emrick-----	0-16	Loam-----	ML, CL-ML, CL	A-4, A-6	0-1	95-100	95-100	85-100	60-90	20-40	NP-15
	16-34	Loam-----	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	34-60	Loam, sandy loam, fine sand.	ML, SM	A-4, A-2	0-5	95-100	95-100	65-100	30-90	20-40	NP-10
25D*, 25E*:											
Esmond-----	0-9	Loam-----	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	9-60	Loam, fine sandy loam, silt loam.	ML, SM	A-4	0-5	95-100	95-100	70-100	40-90	20-40	NP-10
Heimdal-----	0-8	Loam-----	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-19	Loam-----	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	19-60	Loam, silt loam, sandy clay loam.	ML, SM	A-4, A-2	0-5	95-100	95-100	65-100	30-90	20-40	NP-10
26E*:											
Esmond-----	0-9	Loam-----	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	9-60	Loam, fine sandy loam, silt loam.	ML, SM	A-4	0-5	95-100	95-100	70-100	40-90	20-40	NP-10
Sioux-----	0-9	Loam-----	ML, CL	A-4, A-6	0-5	95-100	85-100	70-90	55-75	30-40	5-15
	9-60	Sand and gravel	GM, GP, SM, SP	A-1	0	25-75	10-60	5-35	0-25	<25	NP-5
27C*, 28D*:											
Barnes-----	0-8	Loam-----	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-100	60-90	20-40	5-15
	8-18	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
	18-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	55-80	25-40	5-15
Sioux-----	0-9	Loam-----	ML, CL	A-4, A-6	0-5	95-100	85-100	70-90	55-75	30-40	5-15
	9-60	Sand and gravel	GM, GP, SM, SP	A-1	0	25-75	10-60	5-35	0-25	<25	NP-5
30D*:											
Barnes-----	0-8	Very stony loam	CL, ML, CL-ML	A-4, A-6	3-25	95-100	90-100	85-100	60-90	20-40	3-15
	8-18	Loam, clay loam	CL, CL-ML	A-4, A-6	0-20	95-100	90-100	80-95	60-80	25-40	5-15
	18-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-15	95-100	90-100	80-95	60-80	25-40	5-15

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>	4	10	40	200	<u>Pct</u>	
30D*: Buse-----	0-8 8-60	Very stony loam Loam, clay loam	ML, CL CL	A-4, A-6 A-4, A-6	10-70 5-30	90-100 90-100	85-95 85-95	70-90 70-90	55-80 60-80	30-40 25-40	5-15 8-15
31B----- Towner	0-8 8-34 34-60	Fine sandy loam Loamy sand, loamy fine sand, fine sand. Loam, silt loam, silty clay loam.	SM SM, SM-SC CL, CL-ML	A-2, A-4 A-2 A-4, A-6, A-7	0 0 0-5	100 100 95-100	100 95-100 95-100	60-85 50-80 85-95	30-45 15-35 60-80	<30 <25 25-50	NP-5 NP-5 5-30
33C----- Dickey	0-8 8-28 28-60	Fine sandy loam Loamy fine sand, loamy sand, fine sand. Loam, clay loam, silty clay loam.	SM, SM-SC SM ML, CL, CL-ML	A-4 A-2-4 A-4, A-6	0 0 0-5	100 100 95-100	100 100 90-100	65-85 50-80 85-100	35-50 15-35 60-90	15-25 --- 24-40	NP-5 NP 4-20
34*, 34B*, 34C*: Embsen-----	0-12 12-34 34-60	Fine sandy loam Fine sandy loam, sandy loam. Fine sandy loam, sandy loam, loamy fine sand.	SM, ML SM SM	A-2, A-4 A-2, A-4 A-2, A-4	0 0 0	100 100 100	100 100 100	60-95 60-85 50-80	30-65 30-50 15-50	<35 --- ---	NP-10 NP NP
Heimdal-----	0-8 8-19 19-60	Loam----- Loam----- Loam, silt loam, sand, sandy clay loam.	ML ML ML, SM	A-4 A-4 A-4, A-2	0-1 0-1 0-5	95-100 95-100 95-100	95-100 95-100 95-100	85-100 85-95 65-100	60-90 60-75 30-90	20-40 20-40 20-40	NP-10 NP-10 NP-10
41----- Overly	0-10 10-60	Silty clay loam Silty clay loam, silt loam, clay loam.	CL CL, CL-ML	A-6, A-7 A-6, A-7, A-4	0 0	100 100	100 100	90-100 90-100	80-95 80-95	30-45 25-50	10-25 5-30
42----- Gardena	0-15 15-60	Silt loam----- Silt loam, very fine sandy loam, loam.	ML ML	A-4 A-4	0 0	100 100	100 100	75-95 75-95	60-90 55-90	25-40 20-40	NP-10 NP-10
42B*: Gardena-----	0-15 15-60	Silt loam----- Silt loam, very fine sandy loam, loam.	ML ML	A-4 A-4	0 0	100 100	100 100	75-95 75-95	60-90 55-90	25-40 20-40	NP-10 NP-10
Eckman-----	0-11 11-26 26-60	Silt loam----- Silt loam, very fine sandy loam. Silt loam, very fine sandy loam, fine sandy loam.	ML ML ML, SM	A-4 A-4 A-4	0 0 0	100 100 100	100 100 100	85-100 85-95 65-95	60-90 55-90 40-90	20-40 20-40 <40	NP-10 NP-10 NP-10

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
43C*: Eckman-----	0-11	Silt loam-----	ML	A-4	0	100	100	85-100	60-90	20-40	NP-10
	11-26	Silt loam, very fine sandy loam.	ML	A-4	0	100	100	85-95	55-90	20-40	NP-10
	26-60	Silt loam, very fine sandy loam, fine sandy loam.	ML, SM	A-4	0	100	100	65-95	40-90	<40	NP-10
Zell-----	0-8	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	95-100	85-100	80-100	25-40	5-15
	8-60	Silt loam, very fine sandy loam, loam.	CL, CL-ML	A-4, A-6	0	100	95-100	85-100	80-100	25-40	5-15
44----- Glyndon	0-14	Silt loam-----	OL, ML	A-4	0	100	100	95-100	70-95	20-40	NP-10
	14-46	Silt loam, very fine sandy loam.	ML, CL-ML, CL	A-4	0	100	100	90-100	60-95	20-30	NP-10
	46-60	Loamy very fine sand, very fine sand, silt loam	ML, SM, SC, CL	A-4	0	100	100	85-100	35-75	10-30	NP-10
45----- Bearden	0-10	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	90-100	70-90	20-40	5-20
	10-23	Silt loam, silty clay loam, loam	CL	A-6, A-7	0	100	100	90-100	70-95	30-50	10-25
	23-60	Silt loam, silty clay loam, loam	CL	A-6, A-7	0	100	100	90-100	70-95	30-50	10-25
46----- Borup	0-12	Silt loam-----	OL, ML	A-4	0	100	100	95-100	70-95	20-40	NP-5
	12-30	Very fine sandy loam, loamy very fine sand, silt loam.	ML	A-4	0	100	100	90-100	60-95	<30	NP-5
	30-60	Very fine sand, very fine sandy loam, silt loam	ML	A-4	0	100	100	85-100	50-90	<30	NP-5
47----- Fossum	0-19	Fine sandy loam	SM, SC, SM-SC	A-4	0	100	100	60-85	35-50	<20	NP-10
	19-60	Loamy fine sand, sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	100	60-80	5-30	---	NP
50B----- Great Bend	0-9	Silt loam-----	CL, ML	A-4, A-6, A-7	0	100	100	95-100	90-100	30-45	5-20
	9-25	Silt loam, silty clay loam.	CL, ML	A-6, A-7, A-4	0	100	100	95-100	90-100	30-45	5-20
	25-60	Stratified silt loam to silty clay loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-45	5-20
52B*: Embden-----	0-12	Fine sandy loam	SM, ML	A-2, A-4	0	100	100	60-95	30-65	<35	NP-10
	12-34	Fine sandy loam, sandy loam.	SM	A-2, A-4	0	100	100	60-85	30-50	---	NP
	34-60	Fine sandy loam, sandy loam, loamy fine sand.	SM	A-2, A-4	0	100	100	50-80	15-50	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches Pct	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>										
52B*: Egeland-----	0-7	Fine sandy loam	SM, SM-SC, SC	A-2, A-4	0	100	95-100	75-100	30-50	20-30	NP-10
	7-31	Sandy loam, fine; sandy loam.	SM, SM-SC, SC	A-2, A-4	0	95-100	85-100	70-95	15-50	20-30	NP-10
	31-60	Loamy sand, loamy fine sand.	SM, SP-SM	A-2	0	95-100	85-100	70-90	10-35	<25	NP-5
53----- Hecla	0-26	Fine sandy loam	SM, SM-SC	A-2	0	100	95-100	85-100	15-35	15-30	NP-7
	26-60	Loamy sand, loamy fine sand, fine sand	SM, SM-SC	A-2	0	100	95-100	85-100	15-35	15-30	NP-7
54B*: Hecla-----	0-26	Fine sandy loam	SM, SM-SC	A-2	0	100	95-100	85-100	15-35	15-30	NP-7
	26-60	Loamy sand, loamy fine sand, fine sand	SM, SM-SC	A-2	0	100	95-100	85-100	15-35	15-30	NP-7
Maddock-----	0-12	Fine sandy loam	SM	A-2, A-4	0	100	100	60-85	30-50	---	NP
	12-60	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	100	60-95	5-35	---	NP
58*: Hecla-----	0-26	Loamy fine sand	SM, SM-SC	A-2	0	100	95-100	85-100	15-35	15-30	NP-7
	26-60	Loamy sand, loamy fine sand.	SM, SM-SC	A-2	0	100	95-100	85-100	15-35	15-30	NP-7
Maddock-----	0-21	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	21-60	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	60-95	5-35	---	NP
59B*: Maddock-----	0-21	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	21-60	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	60-95	5-35	---	NP
Hecla-----	0-26	Loamy fine sand	SM, SM-SC	A-2	0	100	95-100	85-100	15-35	15-30	NP-7
	26-60	Loamy sand, loamy fine sand, fine sand	SM, SM-SC	A-2	0	100	95-100	85-100	15-35	15-30	NP-7
59D----- Maddock	0-21	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	21-60	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	60-95	5-35	---	NP
61, 61B----- Renshaw	0-7	Loam-----	ML, CL	A-4, A-6	0-5	95-100	90-100	70-100	50-75	30-40	5-15
	7-16	Loam, clay loam, gravelly loam.	SM-SC, SC, CL-ML, CL	A-4, A-6	0-5	95-100	55-95	45-90	35-70	25-35	5-15
	16-60	Sand and gravel	SW, SM, GW, GW-GM	A-1	0-5	45-95	40-70	10-50	0-15	<25	NP-5

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
63, 63B, 63C----- Brantford	0-16	Loam-----	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	80-90	60-80	15-35	3-15
	16-60	Sand and gravel	SM, GP-GM, SP-SM, GM	A-1, A-2	5-25	50-95	30-75	15-60	10-30	---	NP
64----- Divide	0-7	Loam-----	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-95	60-85	25-40	5-20
	7-22	Loam, clay loam, gravelly loam.	CL, CL-ML	A-4, A-6	0-3	95-100	80-100	60-90	55-80	25-40	5-20
	22-60	Stratified sand to gravelly sand.	GM, SM, GP-GM, SP-SM	A-1	0-5	25-75	15-65	10-40	5-25	---	NP
65, 65B----- Vang	0-17	Loam-----	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-80	25-45	5-15
	17-30	Loam, clay loam	ML, CL, SM, SC	A-4, A-6, A-7	0	65-100	50-100	40-100	35-80	25-45	5-15
	30-60	Sand and gravel	SP-SM, SM, GM, GP-GM	A-1, A-2	5-25	50-95	30-75	15-60	10-30	---	NP
66, 67----- Marysland	0-8	Loam-----	CL	A-6, A-7	0	95-100	95-100	85-95	50-80	30-50	10-25
	8-26	Loam, clay loam, sandy clay loam.	CL, SC	A-6	0	90-100	85-100	80-95	45-80	20-40	10-20
	26-60	Stratified fine sand to gravelly coarse sand.	SP-SM, SM	A-1, A-2, A-3	0	70-95	50-90	35-70	5-20	---	NP
68B----- Arvilla	0-8	Sandy loam-----	SM, SC, SM-SC	A-2, A-4	0	100	100	60-80	30-45	10-30	NP-10
	8-22	Coarse sandy loam, sandy loam.	SM, SC, SM-SC	A-2, A-4	0	95-100	90-100	60-70	30-40	10-30	NP-10
	22-60	Sand and gravel	SP-SM, GP, SP, GP-GM	A-1	0	35-95	25-80	10-50	0-10	---	NP
70B----- Binford	0-6	Sandy loam-----	SM, ML, SC, CL	A-2, A-4	0	95-100	95-100	60-95	30-65	15-30	NP-10
	6-20	Sandy loam, coarse sandy loam, loam.	SM, ML, SC, CL	A-2, A-4	0	95-100	95-100	60-85	30-60	10-30	NP-10
	20-60	Stratified shaly sandy loam to gravelly coarse sand.	SM, GP-GM, GM, SP-SM	A-1, A-2, A-3	0	50-90	40-85	25-55	5-15	---	NP
71*, 71B*:----- Svea	0-12	Loam-----	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	12-22	Loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-90	20-45	5-25
	22-60	Loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-80	20-50	5-30
Cresbard-----	0-8	Loam-----	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-80	30-40	5-15
	8-16	Clay loam, silty clay.	CL, CH	A-7	0	100	100	90-100	70-80	40-60	15-30
	16-60	Clay loam, loam	CL, CH	A-6, A-7	0-5	100	100	85-100	60-80	35-55	10-30

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
73*: Larson-----	0-7	Loam-----	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	75-100	50-90	15-40	5-20
	7-20	Loam, clay loam	CL	A-6, A-7	0-5	95-100	85-100	75-100	60-80	30-45	10-25
	20-60	Loam, clay loam	CL, CL-ML	A-6, A-4, A-7	0-5	95-100	85-100	75-100	60-90	15-45	5-25
Cathay-----	0-9	Loam-----	ML, CL, CL-ML	A-4	0-5	95-100	90-100	75-95	50-95	25-35	5-10
	9-25	Clay loam, loam	CL	A-6	0-5	95-100	90-100	85-95	65-85	25-40	10-25
	25-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-95	60-75	25-40	3-18
74B*: Cavour-----	0-10	Silt loam-----	ML, CL	A-4, A-6, A-7	0	100	95-100	85-100	60-85	30-45	5-20
	10-23	Clay, clay loam, silty clay loam.	CL, CH	A-7	0	100	95-100	90-100	70-95	40-65	15-35
	23-60	Clay loam, loam	CL, CH	A-7, A-6	0-5	95-100	95-100	85-100	60-85	35-65	12-35
Miranda-----	0-5	Loam-----	CL-ML, CL	A-4, A-6	0	100	100	85-95	60-75	25-40	5-15
	5-22	Clay loam	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	30-50	10-25
	22-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	30-50	10-25
75----- Ryan	0-3	Silty clay-----	CH	A-7	0	100	100	95-100	90-95	50-75	25-50
	3-60	Silty clay, clay	CH	A-7	0	100	100	90-100	75-95	50-75	25-50
78*: LaDelle-----	0-17	Silt loam-----	ML, CL	A-4, A-6, A-7	0	100	100	90-100	75-100	30-45	5-20
	17-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	75-100	25-45	5-20
Aberdeen-----	0-9	Silt loam-----	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25
	9-26	Silty clay, clay, silty clay loam.	CH, MH	A-7	0	100	100	95-100	90-100	50-75	20-45
	26-60	Silt loam, silty clay loam, clay	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
82B----- Darnen	0-22	Loam-----	OL, ML, CL, CL-ML	A-4	0	100	100	85-100	60-90	20-35	2-10
	22-34	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-90	20-45	5-25
	34-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	90-100	90-100	80-95	60-85	20-45	5-25
83----- LaDelle	0-17	Silt loam-----	ML, CL	A-4, A-6, A-7	0	100	100	90-100	75-100	30-45	5-20
	17-60	Silt loam, clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	75-100	25-45	5-20

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches Pct	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
85----- Lamoure	0-26	Silt loam, silty clay loam.	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	26-40	Silty clay loam, silt loam.	CL, CH	A-7	0	100	100	90-100	85-100	40-60	15-30
	40-60	Stratified sandy loam to silty clay loam.	CL, SC	A-6, A-7	0	100	95-100	70-95	35-90	30-50	10-30
86----- LaDelle	0-17	Silt loam-----	ML, CL	A-4, A-6, A-7	0	100	100	90-100	75-100	30-45	5-20
	17-60	Silt loam, silty clay loam, loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	75-100	25-45	5-20
89----- Grano	0-10	Silty clay-----	CH	A-7	0	100	100	95-100	80-95	50-75	25-50
	10-42	Silty clay, clay	CH	A-7	0	100	100	95-100	80-95	50-75	25-50
	42-60	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	90-100	75-95	40-75	20-50
90*: Parnell-----	0-14	Silty clay loam	CL, CH, OL, OH	A-7	0	100	100	95-100	85-95	40-60	15-30
	14-60	Clay loam, silty clay loam, silty clay.	CH, MH	A-7	0	100	95-100	90-100	70-95	50-80	20-45
Lallie-----	0-2	Loam-----	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-90	20-45	3-25
	2-60	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-50
91C, 91E----- Sioux	0-9	Gravelly loam---	SM, SM-SC	A-4, A-2	0-5	60-90	50-80	45-70	25-50	20-35	NP-7
	9-60	Sand and gravel	GM, GP, SM, SP	A-1	0	25-75	10-60	5-35	0-25	<25	NP-5
98C, 98E----- Coe	0-7	Shaly loam-----	SM, GM-GC, SM-SC, GM	A-4, A-2	0-10	50-80	40-70	30-60	25-50	<25	NP-5
	7-60	Shaly coarse sand, shaly loamy coarse sand, very shaly sand.	SM, GP-GM, SP-SM, GM	A-1, A-2	5-25	50-95	30-75	15-60	10-30	---	NP
99C----- Claire	0-5	Loamy coarse sand.	SP-SM, SM	A-1, A-2, A-3	0	95-100	95-100	30-75	5-15	<20	NP
	5-42	Coarse sand, loamy coarse sand.	SM, SP-SM	A-1, A-2, A-3	0	95-100	95-100	30-75	5-15	<20	NP
	42-60	Sandy clay loam	SM-SC, SC	A-4, A-6	0	90-100	85-100	80-90	35-50	20-35	5-15
101----- Lallie	0-2	Loam-----	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-90	20-45	3-25
	2-60	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-50

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct						
104----- Lallie	0-2	Loam-----	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	25-40	5-20
	2-60	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	85-95	45-70	20-45
106----- Lallie	0-2	Loam-----	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-90	20-45	3-25
	2-60	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	85-95	40-70	20-50
107----- Minnewaukan	0-5	Loamy fine sand	SM	A-2	0	90-100	70-100	50-85	15-30	<20	NP
	5-60	Sand, loamy sand, fine sand.	SM, SP-SM	A-2, A-3	0	90-100	70-100	60-95	5-35	<20	NP
109*. Aqunts											
110B*: Aastad	0-18	Loam-----	ML, CL	A-6, A-7	0-5	95-100	90-100	80-95	50-75	35-45	10-20
	18-38	Clay loam-----	CL	A-7	0-5	95-100	85-100	75-95	50-75	40-50	15-25
	38-60	Clay loam, loam	CL	A-7, A-6	0-5	90-100	85-100	75-95	55-75	35-50	12-25
Bottineau-----	0-6	Loam-----	CL, CL-ML	A-4, A-6	0	95-100	85-100	75-95	55-75	15-30	5-15
	6-19	Clay loam, loam	CL, CL-ML	A-4, A-6	0	95-100	85-100	75-100	55-80	25-40	5-20
	19-60	Clay loam, loam	CL, CL-ML	A-4, A-6	0	95-100	85-100	75-100	55-80	25-40	5-20
112F----- Edgeley Variant	0-11	Loam-----	ML, CL, CL-ML	A-4, A-6	0-5	95-100	95-100	85-95	60-75	20-40	5-25
	11-24	Loam, clay loam	ML, CL, CL-ML	A-4, A-6, A-7	0-5	85-100	75-100	65-95	55-95	20-50	5-30
	24-60	Very shaly loam, very shaly clay loam.	GM, GP-GM, SM, SP-SM	A-1, A-2	5-25	50-90	40-85	25-55	10-30	---	NP
113C, 113D----- Bottineau	0-6	Loam-----	CL, CL-ML	A-4, A-6	0	95-100	85-100	75-95	55-75	15-30	5-15
	6-19	Clay loam, loam	CL, CL-ML	A-4, A-6	0	95-100	85-100	75-100	55-80	25-40	5-20
	19-60	Clay loam, loam	CL, CL-ML	A-4, A-6	0	95-100	85-100	75-100	55-80	25-40	5-20
119----- Aberdeen	0-9	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-30
	9-26	Silty clay, clay, silty clay loam.	CH, MH	A-7	0	100	100	95-100	90-100	50-75	20-45
	26-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-15
122*: Fram	0-13	Loam-----	ML, SM	A-4	0-1	90-100	70-100	55-75	40-70	20-40	NP-10
	13-60	Sandy loam, fine sandy loam, loam.	SM, SC, SM-SC	A-2, A-4	0-1	90-100	70-95	45-70	25-50	<30	NP-10
Cathay-----	0-9	Loam-----	ML, CL, CL-ML	A-4	0-5	95-100	90-100	75-95	50-95	25-35	5-10
	9-25	Clay loam, loam	CL	A-6	0-5	95-100	90-100	85-95	65-85	25-40	10-25
	25-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-95	60-75	25-40	3-18
123*, 123B*: Emrick	0-16	Loam-----	ML, CL-ML, CL	A-4, A-6	0-1	95-100	95-100	85-100	60-90	20-40	NP-15
	16-34	Loam-----	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	34-60	Loam, sandy loam, fine sand.	ML, SM	A-4, A-2	0-5	95-100	95-100	65-100	30-90	20-40	NP-10

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
123*, 123B*: Cathay-----	0-9	Loam-----	ML, CL, CL-ML	A-4	0-5	95-100	90-100	75-95	50-95	25-35	5-10
	9-25	Clay loam, loam	CL	A-6	0-5	95-100	90-100	85-95	65-85	25-40	10-25
	25-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6	0-5	95-100	90-100	85-95	60-75	25-40	3-18
124C*: Heimdal-----	0-8	Loam-----	ML	A-4	0-1	95-100	95-100	85-100	60-90	20-40	NP-10
	8-19	Loam-----	ML	A-4	0-1	95-100	95-100	85-95	60-75	20-40	NP-10
	19-60	Loam, silt loam, sandy clay loam	ML, SM	A-4, A-2	0-5	95-100	95-100	65-100	30-90	20-40	NP-10
Sioux-----	0-9	Loam-----	ML, CL	A-4, A-6	0-5	95-100	85-100	70-90	55-75	30-40	5-15
	9-60	Sand and gravel	GM, GP, SM, SP	A-1	0	25-75	10-60	5-35	0-25	<25	NP-5
125C*: Heimdal-----	0-8	Very stony loam	ML	A-4	1-15	95-100	95-100	85-100	60-90	20-40	NP-10
	8-19	Loam-----	ML	A-4	1-10	95-100	95-100	85-95	60-75	20-40	NP-10
	19-60	Loam, silt loam, sandy clay loam	ML, SM, SC, CL	A-4, A-2, A-6	1-10	95-100	95-100	65-100	30-90	15-40	NP-15
Emrick-----	0-16	Very stony loam	ML	A-4	1-15	95-100	95-100	85-100	60-90	20-40	NP-10
	16-34	Loam-----	ML	A-4	1-10	95-100	95-100	85-95	60-75	20-40	NP-10
	34-60	Loam, sandy loam, fine sand.	ML, SM	A-4, A-2	1-10	95-100	95-100	65-100	30-90	20-40	NP-10
125F*: Heimdal-----	0-8	Very stony loam	ML	A-4	1-15	95-100	95-100	85-100	60-90	20-40	NP-10
	8-19	Loam-----	ML	A-4	1-10	95-100	95-100	85-95	60-75	20-40	NP-10
	19-60	Loam, silt loam, sandy clay loam	ML, SM, SC, CL	A-4, A-2, A-6	1-10	95-100	95-100	65-100	30-90	15-40	NP-15
Esmond-----	0-9	Very stony loam	ML	A-4	1-15	95-100	95-100	85-95	60-75	20-40	NP-10
	9-60	Loam, fine sandy loam, silt loam.	ML, SM	A-4	1-10	95-100	95-100	70-100	40-90	20-40	NP-10
126----- Fram	0-13	Loam-----	SM, ML	A-4	0-1	90-100	70-100	55-75	40-70	20-40	NP-10
	13-60	Sandy loam, fine sandy loam, loam.	SM, SM-SC, SC	A-2, A-4	0-1	90-100	70-95	45-70	25-50	15-30	NP-10
127----- Fram	0-13	Loam-----	ML, SM	A-4	0-1	90-100	70-100	55-75	40-70	20-40	NP-10
	13-60	Sandy loam, fine sandy loam, loam.	SM, SC, SM-SC	A-2, A-4	0-1	90-100	70-95	45-70	25-50	<30	NP-10
129*: Colvin-----	0-12	Silt loam-----	CL	A-6	0	100	100	90-100	80-95	20-35	10-20
	12-60	Silt loam, silty clay loam, loam	CL	A-6, A-7	0	100	100	90-100	80-95	20-50	10-30

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
129*: Borup-----	0-12	Silt loam-----	OL, ML	A-4	0	100	100	95-100	70-95	20-40	NP-7
	12-30	Very fine sandy loam, loamy very fine sand, silt loam.	ML, CL-ML	A-4	0	100	100	90-100	60-95	20-30	NP-7
	30-60	Very fine sand, very fine sandy loam, silt loam.	ML, CL-ML	A-4	0	100	100	85-100	50-90	15-30	NP-7
131D----- Miranda Variant	0-1	Loam-----	CL-ML, CL	A-4, A-6	0	100	100	85-95	60-75	25-40	5-15
	1-42	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0-5	95-100	95-100	90-100	75-95	30-50	10-25
	42-60										
133----- Fordville	0-7	Loam-----	ML, CL	A-4, A-6, A-7	0	100	100	70-85	55-75	30-45	5-20
	7-24	Loam, silt loam, coarse sandy loam.	CL, ML	A-4, A-6, A-7	0	100	95-100	70-95	55-80	30-45	5-15
	24-60	Sand and gravel	SW, GP, SP, SP-SM	A-1	0	65-85	45-70	15-40	0-10	<25	NP-5
134*: Borup-----	0-12	Silt loam-----	OL, ML	A-4	0	100	100	95-100	70-95	20-40	NP-5
	12-30	Very fine sandy loam, loamy very fine sand, silt loam.	ML	A-4	0	100	100	90-100	60-95	<30	NP-5
	30-60	Very fine sand, very fine sandy loam, silt loam	ML	A-4	0	100	100	85-100	50-90	<30	NP-5
Vallers-----	0-9	Loam-----	OL, ML	A-4	0	95-100	90-100	80-90	65-80	30-40	4-10
	9-22	Clay loam, loam	CL	A-6	0	95-100	90-97	90-95	70-80	30-40	11-20
	22-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	95-100	90-97	85-95	60-75	20-40	5-20
135*: Miranda-----	0-5	Loam-----	CL-ML, CL	A-4, A-6	0	100	100	85-95	60-75	25-40	5-15
	5-22	Clay loam	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	30-50	10-25
	22-60	Loam, clay loam	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	30-50	10-25
Larson-----	0-7	Loam-----	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	75-100	50-90	15-40	5-20
	7-20	Loam, clay loam	CL	A-6, A-7	0-5	95-100	85-100	75-100	60-80	30-45	10-25
	20-60	Loam, clay loam	CL, CL-ML	A-6, A-4, A-7	0-5	95-100	85-100	75-100	60-90	15-45	5-25
137----- Stirum	0-9	Loamy fine sand	SM	A-2, A-4	0	100	100	50-80	20-40	---	NP
	9-18	Loam, fine sandy loam, sandy loam.	SC, CL, ML, SM	A-2, A-4	0	100	100	60-95	30-75	15-30	NP-10
	18-60	Stratified silt loam to loamy sand.	SM, CL, ML, SC	A-2, A-4	0	100	100	50-100	15-90	<30	NP-10

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
140B*: Svea-----	0-12	Loam-----	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	12-22	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-90	20-45	5-25
	22-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-80	20-50	5-30
Buse-----	0-8	Loam-----	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-20
	8-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-20
141*: Embsden-----	0-12	Fine sandy loam	SM, ML	A-2, A-4	0	100	100	60-95	30-65	<35	NP-10
	12-34	Fine sandy loam, sandy loam.	SM	A-2, A-4	0	100	100	60-85	30-50	---	NP
	34-60	Fine sandy loam, sandy loam, loamy fine sand.	SM	A-2, A-4	0	100	100	50-80	15-50	---	NP
Letcher-----	0-10	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	100	60-85	30-55	<30	NP-8
	10-23	Sandy loam, fine sandy loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	100	60-85	30-55	<30	NP-8
	23-39	Sandy loam, fine sandy loam	CL-ML, SC, CL, SM-SC	A-2, A-4, A-6	0	100	100	60-95	30-75	15-35	5-15
	39-60	Sandy loam, sand, loamy sand.	SM, SC, SM-SC	A-2, A-4	0	100	100	60-70	30-40	<30	NP-10
144*, 144B*: Hamerly-----	0-9	Loam-----	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-25
	9-22	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	22-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
Cresbard-----	0-8	Loam-----	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-80	30-40	5-15
	8-16	Clay, silty clay	CL, CH	A-7	0	100	100	90-100	70-80	40-60	15-30
	16-60	Clay loam, loam	CL, CH	A-6, A-7	0-5	100	100	85-100	60-80	35-55	10-30
145----- Grano	0-10	Silty clay-----	CH	A-7	0	100	100	95-100	80-95	50-75	25-50
	10-60	Clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	90-100	75-95	40-75	20-50
146*: Hamerly-----	0-9	Loam-----	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-25
	9-22	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	22-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	90-100	80-95	60-75	20-45	5-25
Tonka-----	0-22	Loam-----	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-40	5-25
	22-38	Silty clay loam, clay loam, clay.	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	15-35
	38-60	Silty clay loam, clay loam, loam	CL	A-6, A-7	0-3	100	95-100	90-100	70-90	20-50	10-30

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
149B----- Maddock	0-21	Loamy fine sand	SM	A-2	0	100	100	50-80	15-35	---	NP
	21-60	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	60-95	5-35	---	NP
150*. Pits											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	Mmhos/cm				
3----- Parnell	0-14 14-60	0.2-0.6 0.06-0.2	0.18-0.22 0.13-0.19	6.1-7.8 6.6-7.8	<2 <2	Moderate High-----	0.28 0.28	5	7
4----- Fargo	0-9 9-30 30-60	0.06-0.2 0.06-0.2 0.06-0.2	0.18-0.23 0.14-0.17 0.14-0.17	6.6-7.3 6.6-7.8 7.9-8.4	<2 <2 <2	High----- High----- High-----	0.32 0.32 0.32	5	7
5----- Hegne	0-10 10-24 24-60	<0.2 <0.2 <0.06	0.14-0.17 0.13-0.16 0.09-0.13	7.4-8.4 7.4-8.4 7.4-8.4	<2 <2 <2	High----- High----- High-----	0.32 0.32 0.32	5	4
7----- Colvin	0-12 12-60	0.6-2.0 0.2-2.0	0.20-0.22 0.16-0.20	7.4-9.0 7.4-9.0	<2 <2	Moderate High-----	0.32 0.32	5	4L
8----- Colvin	0-12 12-60	0.6-2.0 0.2-2.0	0.20-0.22 0.16-0.20	7.4-9.0 7.4-9.0	<2 <2	Moderate High-----	0.32 0.32	5	4L
9----- Rauville	0-20 20-60	0.6-2.0 0.2-2.0	0.19-0.22 0.17-0.20	7.4-8.4 7.4-8.4	<2 <2	Moderate Moderate	0.28 0.28	5	4L
11*: Svea-----	0-12 12-22 22-60	0.6-2.0 0.6-2.0 0.2-2.0	0.20-0.24 0.17-0.22 0.14-0.19	6.6-7.8 6.6-7.8 7.4-8.4	<2 <2 <2	Low----- Moderate Moderate	0.28 0.28 0.37	5	6
Barnes-----	0-8 8-18 18-60	0.6-2.0 0.6-2.0 0.2-0.6	0.13-0.24 0.15-0.19 0.14-0.19	6.6-7.8 6.6-7.8 7.4-8.4	<2 <4 <8	Low----- Moderate Moderate	0.28 0.28 0.37	5	6
12B*: Barnes-----	0-8 8-18 18-60	0.6-2.0 0.6-2.0 0.2-0.6	0.13-0.24 0.15-0.19 0.14-0.19	6.6-7.8 6.6-7.8 7.4-8.4	<2 <4 <8	Low----- Moderate Moderate	0.28 0.28 0.37	5	6
Svea-----	0-12 12-22 22-60	0.6-2.0 0.6-2.0 0.2-2.0	0.20-0.24 0.17-0.22 0.14-0.19	6.6-7.8 6.6-7.8 7.4-8.4	<2 <2 <2	Low----- Moderate Moderate	0.28 0.28 0.37	5	6
13C*, 13D*: Barnes-----	0-8 8-18 18-60	0.6-2.0 0.6-2.0 0.2-0.6	0.13-0.24 0.15-0.19 0.14-0.19	6.6-7.8 6.6-7.8 7.4-8.4	<2 <4 <8	Low----- Moderate Moderate	0.28 0.28 0.37	5	6
Buse-----	0-8 8-60	0.2-2.0 0.2-0.6	0.17-0.22 0.14-0.19	6.6-8.4 7.4-8.4	<2 <2	Moderate Moderate	0.28 0.37	5	4L
14*, 14B*: Svea-----	0-12 12-22 22-60	0.6-2.0 0.6-2.0 0.2-2.0	0.20-0.24 0.17-0.22 0.14-0.19	6.6-7.8 6.6-7.8 7.4-8.4	<2 <2 <2	Low----- Moderate Moderate	0.28 0.28 0.37	5	6
Hamerly-----	0-9 9-22 22-60	0.6-2.0 0.6-2.0 0.2-2.0	0.17-0.22 0.15-0.19 0.14-0.19	7.4-8.4 7.4-8.4 7.4-8.4	<2 <2 <2	Moderate Moderate Moderate	0.28 0.28 0.37	5	4L
15----- Vallers	0-9 9-22 22-60	0.6-2.0 0.2-0.6 0.2-0.6	0.14-0.16 0.10-0.13 0.11-0.13	7.4-8.4 7.9-8.4 7.4-8.4	4-16 4-16 4-16	Low----- Low----- Low-----	0.28 0.28 0.28	5	4L
16----- Vallers	0-9 9-22 22-60	0.6-2.0 0.2-0.6 0.2-0.6	0.22-0.24 0.15-0.19 0.17-0.19	7.4-8.4 7.9-8.4 7.4-8.4	<2 <2 <2	Low----- Moderate Low-----	0.28 0.28 0.28	5	4L

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	Mmhos/cm				
18E----- Buse	0-8 8-60	0.2-2.0 0.2-0.6	0.17-0.22 0.14-0.19	6.6-8.4 7.4-8.4	<2 <2	Moderate Moderate	0.28 0.37	5	4L
19----- Tonka	0-22 22-38 38-60	0.6-2.0 0.06-0.2 0.2-0.6	0.18-0.23 0.14-0.19 0.14-0.19	5.6-6.5 5.6-7.3 6.6-9.0	<2 <2 <2	Low----- High----- Moderate	0.32 0.43 0.43	5	6
21*: Emrick-----	0-16 16-34 34-60	0.6-2.0 0.6-2.0 0.6-6.0	0.20-0.24 0.17-0.19 0.11-0.21	6.6-7.3 6.6-7.3 7.4-8.4	<2 <2 <2	Low----- Low----- Low-----	0.28 0.28 0.37	5	5
Heimdal-----	0-8 8-19 19-60	0.6-2.0 0.6-2.0 0.6-6.0	0.20-0.24 0.17-0.19 0.11-0.21	6.6-7.3 6.6-7.8 7.9-8.4	<2 <2 <2	Low----- Low----- Low-----	0.28 0.28 0.37	5	5
22B*: Heimdal-----	0-8 8-19 19-60	0.6-2.0 0.6-2.0 0.6-6.0	0.20-0.24 0.17-0.19 0.11-0.21	6.6-7.3 6.6-7.8 7.9-8.4	<2 <2 <2	Low----- Low----- Low-----	0.28 0.28 0.37	5	5
Emrick-----	0-16 16-34 34-60	0.6-2.0 0.6-2.0 0.6-6.0	0.20-0.24 0.17-0.19 0.11-0.21	6.6-7.3 6.6-7.3 7.4-8.4	<2 <2 <2	Low----- Low----- Low-----	0.28 0.28 0.37	5	5
23C*: Heimdal-----	0-8 8-19 19-60	0.6-2.0 0.6-2.0 0.6-6.0	0.20-0.24 0.17-0.19 0.11-0.21	6.6-7.3 6.6-7.8 7.9-8.4	<2 <2 <2	Low----- Low----- Low-----	0.28 0.28 0.37	5	5
Esmond-----	0-9 9-60	0.6-2.0 0.6-2.0	0.20-0.22 0.14-0.22	7.4-7.8 7.9-8.4	<2 <2	Low----- Low-----	0.28 0.37	5	5
24*: Fram-----	0-13 13-60	0.6-2.0 0.6-2.0	0.20-0.24 0.13-0.20	7.4-8.4 7.4-8.4	<2 <2	Low----- Low-----	0.28 0.37	5	4L
Emrick-----	0-16 16-34 34-60	0.6-2.0 0.6-2.0 0.6-6.0	0.20-0.24 0.17-0.19 0.11-0.21	6.6-7.3 6.6-7.3 7.4-8.4	<2 <2 <2	Low----- Low----- Low-----	0.28 0.28 0.37	5	5
25D*, 25E*: Esmond-----	0-9 9-60	0.6-2.0 0.6-2.0	0.20-0.22 0.14-0.22	7.4-7.8 7.9-8.4	<2 <2	Low----- Low-----	0.28 0.37	5	5
Heimdal-----	0-8 8-19 19-60	0.6-2.0 0.6-2.0 0.6-6.0	0.20-0.24 0.17-0.19 0.11-0.21	6.6-7.3 6.6-7.8 7.9-8.4	<2 <2 <2	Low----- Low----- Low-----	0.28 0.28 0.37	5	5
26E*: Esmond-----	0-9 9-60	0.6-2.0 0.6-2.0	0.20-0.22 0.14-0.22	7.4-7.8 7.9-8.4	<2 <2	Low----- Low-----	0.28 0.37	5	5
Sioux-----	0-9 9-60	0.6-2.0 6.0-20	0.18-0.20 0.03-0.06	6.6-8.4 7.4-8.4	<2 <2	Low----- Low-----	0.28 0.10	2	8
27C*, 28D*: Barnes-----	0-8 8-18 18-60	0.6-2.0 0.6-2.0 0.2-0.6	0.13-0.24 0.15-0.19 0.14-0.19	6.6-7.8 6.6-7.8 7.4-8.4	<2 <4 <8	Low----- Moderate Moderate	0.28 0.28 0.37	5	6
Sioux-----	0-9 9-60	0.6-2.0 6.0-20	0.18-0.20 0.03-0.06	6.6-8.4 7.4-8.4	<2 <2	Low----- Low-----	0.28 0.10	2	8

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	Mmhos/cm				
30D*:									
Barnes-----	0-8	0.6-2.0	0.13-0.24	6.6-7.3	<2	Low-----	0.20	5	8
	8-18	0.6-2.0	0.15-0.19	6.6-7.8	<2	Low-----	0.32		
	18-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Low-----	0.32		
Buse-----	0-8	0.6-2.0	0.18-0.20	6.6-8.4	<2	Moderate	0.20	5	8
	8-60	0.2-0.6	0.16-0.20	7.4-8.4	2-8	Moderate	0.28		
31B-----	0-8	2.0-6.0	0.13-0.18	6.6-7.8	<2	Low-----	0.20	5	3
Towner-----	8-34	6.0-20	0.06-0.13	6.6-7.8	<2	Low-----	0.17		
	34-60	0.2-2.0	0.14-0.22	7.4-8.4	<2	Moderate	0.37		
33C-----	0-8	2.0-6.0	0.13-0.18	7.4-7.8	<2	Low-----	0.17	5	3
Dickey-----	8-28	6.0-20	0.06-0.12	6.6-7.3	<2	Low-----	0.17		
	28-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Low-----	0.37		
34*, 34B*, 34C*:									
Embsden-----	0-12	2.0-6.0	0.13-0.18	6.6-7.3	<2	Low-----	0.20	5	3
	12-34	2.0-6.0	0.12-0.17	6.6-7.8	<2	Low-----	0.20		
	34-60	2.0-6.0	0.06-0.16	7.9-8.4	<2	Low-----	0.20		
Heimdal-----	0-8	0.6-2.0	0.20-0.24	6.6-7.3	<2	Low-----	0.28	5	5
	8-19	0.6-2.0	0.17-0.19	6.6-7.8	<2	Low-----	0.28		
	19-60	0.6-6.0	0.11-0.21	7.9-8.4	<2	Low-----	0.37		
41-----	0-10	0.2-0.6	0.17-0.23	6.6-7.8	<2	Moderate	0.32	5	7
Overly-----	10-60	0.2-0.6	0.17-0.22	7.4-8.4	<2	Moderate	0.32		
42-----	0-15	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-----	0.28	5	5
Gardena-----	15-60	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low-----	0.43		
42B*:									
Gardena-----	0-15	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-----	0.28	5	5
	15-60	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low-----	0.43		
Eckman-----	0-11	0.6-2.0	0.20-0.24	6.6-7.3	<2	Low-----	0.28	5	5
	11-26	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low-----	0.43		
	26-60	0.6-2.0	0.14-0.22	7.9-8.4	<2	Low-----	0.43		
43C*:									
Eckman-----	0-11	0.6-2.0	0.20-0.24	6.6-7.3	<2	Low-----	0.28	5	5
	11-26	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low-----	0.43		
	26-60	0.6-2.0	0.14-0.22	7.9-8.4	<2	Low-----	0.43		
Zell-----	0-8	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low-----	0.32	5	4L
	8-60	0.6-2.0	0.15-0.20	7.4-8.4	<2	Low-----	0.43		
44-----	0-14	0.6-2.0	0.20-0.23	7.4-9.0	<2	Low-----	0.28	4	4L
Glyndon-----	14-46	2.0-6.0	0.17-0.20	7.9-9.0	<2	Low-----	0.28		
	46-60	2.0-20	0.15-0.19	7.9-8.4	<2	Low-----	0.28		
45-----	0-10	0.6-2.0	0.20-0.24	7.4-8.4	<4	Moderate	0.28	5	4L
Bearden-----	10-23	0.2-2.0	0.16-0.22	7.4-8.4	<8	Moderate	0.28		
	23-60	0.2-2.0	0.16-0.22	7.4-8.4	<8	Moderate	0.43		
46-----	0-12	2.0-6.0	0.20-0.23	7.4-8.4	<2	Low-----	0.28	5	4L
Borup-----	12-30	2.0-6.0	0.17-0.20	7.4-8.4	<2	Low-----	0.28		
	30-60	2.0-20	0.15-0.19	7.9-8.4	<2	Low-----	0.28		
47-----	0-19	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low-----	0.15	5	3
Fossum-----	19-60	6.0-20	0.06-0.11	7.4-8.4	<2	Low-----	0.15		
50B-----	0-9	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.32	5	6
Great Bend-----	9-25	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43		
	25-60	0.2-0.6	0.17-0.20	7.4-9.0	2-4	Moderate	0.43		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	Mmhos/cm				
52B*:									
Embsen-----	0-12	2.0-6.0	0.13-0.18	6.6-7.3	<2	Low-----	0.20	5	3
	12-34	2.0-6.0	0.12-0.17	6.6-7.8	<2	Low-----	0.20		
	34-60	2.0-6.0	0.06-0.16	7.9-8.4	<2	Low-----	0.20		
Egeland-----	0-7	2.0-6.0	0.11-0.17	5.6-7.3	<2	Low-----	0.20	5	3
	7-31	2.0-6.0	0.09-0.15	6.1-7.8	<2	Low-----	0.20		
	31-60	2.0-6.0	0.08-0.10	6.6-8.4	<2	Low-----	0.20		
53-----	0-26	2.0-20	0.10-0.12	6.1-7.8	<2	Low-----	0.17	5	2
Hecla-----	26-60	2.0-20	0.10-0.12	6.1-7.8	<2	Low-----	0.17		
54B*:									
Hecla-----	0-26	2.0-20	0.10-0.12	6.1-7.8	<2	Low-----	0.17	5	2
	26-60	2.0-20	0.10-0.12	6.1-7.8	<2	Low-----	0.17		
Maddock-----	0-12	6.0-20	0.13-0.18	6.6-7.8	<2	Low-----	0.17	5	3
	12-60	6.0-20	0.05-0.13	6.6-8.4	<2	Low-----	0.17		
58*:									
Hecla-----	0-26	2.0-20	0.10-0.12	6.1-7.8	<2	Low-----	0.17	5	2
	26-60	2.0-20	0.10-0.12	6.1-7.8	<2	Low-----	0.17		
Maddock-----	0-21	6.0-20	0.08-0.12	6.6-7.8	<2	Low-----	0.17	5	2
	21-60	6.0-20	0.05-0.13	6.6-8.4	<2	Low-----	0.17		
59B*:									
Maddock-----	0-21	6.0-20	0.08-0.12	6.6-7.8	<2	Low-----	0.17	5	2
	21-60	6.0-20	0.05-0.13	6.6-8.4	<2	Low-----	0.17		
Hecla-----	0-26	2.0-20	0.10-0.12	6.1-7.8	<2	Low-----	0.17	5	2
	26-60	2.0-20	0.10-0.12	6.1-7.8	<2	Low-----	0.17		
59D-----	0-21	6.0-20	0.08-0.12	6.6-7.8	<2	Low-----	0.17	5	2
Maddock-----	21-60	6.0-20	0.05-0.13	6.6-8.4	<2	Low-----	0.17		
61, 61B-----	0-7	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low-----	0.28	3	5
Renshaw-----	7-16	2.0-6.0	0.11-0.18	6.6-7.8	<2	Low-----	0.28		
	16-60	6.0-20	0.03-0.06	6.6-7.8	<2	Low-----	0.10		
63, 63B, 63C-----	0-16	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low-----	0.28	3	5
Brantford-----	16-60	>20	0.02-0.05	7.9-8.4	<2	Low-----	0.10		
64-----	0-7	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low-----	0.28	4	4L
Divide-----	7-22	0.6-2.0	0.16-0.19	7.9-8.4	<2	Low-----	0.28		
	22-60	>6.0	0.03-0.07	7.9-8.4	<2	Low-----	0.10		
65, 65B-----	0-17	0.6-2.0	0.17-0.21	6.6-7.3	<2	Low-----	0.28	4	5
Vang-----	17-30	0.6-2.0	0.15-0.19	6.6-7.8	<2	Low-----	0.28		
	30-60	>6.0	0.02-0.04	7.4-8.4	<2	Low-----	0.10		
66, 67-----	0-8	0.6-2.0	0.17-0.22	7.9-8.4	<2	Moderate	0.28	4	4L
Marysland-----	8-26	0.6-2.0	0.15-0.19	7.9-8.4	<2	Moderate	0.28		
	26-60	>6.0	0.02-0.07	7.9-8.4	<2	Low-----	0.15		
68B-----	0-8	2.0-6.0	0.13-0.15	6.6-7.3	<2	Low-----	0.20	3	3
Arvilla-----	8-22	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low-----	0.20		
	22-60	>6.0	0.02-0.05	7.4-8.4	<2	Low-----	0.10		
70B-----	0-6	2.0-6.0	0.13-0.20	6.6-7.3	<2	Low-----	0.20	3	3
Binford-----	6-20	2.0-6.0	0.12-0.18	7.4-7.8	<2	Low-----	0.20		
	20-60	6.0-20	0.02-0.08	7.4-8.4	<2	Low-----	0.10		
71*, 71B*:									
Svea-----	0-12	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-----	0.28	5	6
	12-22	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate--	0.28		
	22-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate--	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	Mmhos/cm				
Cresbard-----	0-8	0.6-2.0	0.17-0.20	5.6-6.5	<2	Low-----	0.32	3	6
	8-16	0.06-0.6	0.11-0.14	6.1-8.4	2-4	High-----	0.32		
	16-60	0.2-0.6	0.11-0.15	7.4-9.0	2-8	High-----	0.32		
73*: Larson-----	0-7	0.6-2.0	0.16-0.24	6.1-7.3	<2	Moderate	0.32	3	5
	7-20	0.06-0.2	0.10-0.14	7.4-9.0	4-16	Moderate	0.32		
	20-60	0.2-2.0	0.12-0.16	7.9-9.0	2-8	Moderate	0.32		
Cathay-----	0-9	0.6-2.0	0.20-0.23	6.1-7.8	<2	Low-----	0.32	3	6
	9-25	0.06-0.6	0.16-0.19	6.6-8.4	4-8	Moderate	0.32		
	25-60	0.2-0.6	0.17-0.19	7.4-9.0	4-8	Moderate	0.32		
74B*: Cavour-----	0-10	0.6-2.0	0.18-0.22	6.1-7.8	<2	Moderate	0.37	3	6
	10-23	<0.2	0.10-0.16	6.6-9.0	4-16	High-----	0.37		
	23-60	0.06-0.6	0.11-0.15	7.4-9.0	8-16	Moderate	0.37		
Miranda-----	0-5	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low-----	0.32	1	8
	5-22	<0.06	0.14-0.18	6.6-8.4	2-8	Moderate	0.32		
	22-60	<0.06	0.13-0.17	7.9-9.0	4-16	Moderate	0.32		
75----- Ryan	0-3	<0.06	0.15-0.18	7.9-8.4	<2	High-----	0.28	3	4
	3-60	<0.06	0.10-0.14	8.5-9.0	4-12	High-----	0.28		
78*: LaDelle-----	0-17	0.6-2.0	0.18-0.22	6.6-7.8	<2	Moderate	0.28	5	6
	17-60	0.6-2.0	0.18-0.22	7.4-8.4	<2	Moderate	0.28		
Aberdeen-----	0-9	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.32	3	6
	9-26	0.06-0.2	0.13-0.18	6.6-7.8	<4	High-----	0.32		
	26-60	0.2-2.0	0.14-0.17	7.9-9.0	2-8	Low-----	0.43		
82B----- Darnen	0-22	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-----	0.28	5	6
	22-34	0.6-2.0	0.15-0.19	6.1-7.8	<2	Moderate	0.28		
	34-60	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
83----- LaDelle	0-17	0.6-2.0	0.18-0.22	6.6-7.8	<2	Moderate	0.28	5	6
	17-60	0.6-2.0	0.18-0.22	7.4-8.4	<2	Moderate	0.28		
85----- Lamoure	0-26	0.6-2.0	0.19-0.22	7.4-8.4	<4	Moderate	0.28	5	4L
	26-40	0.6-2.0	0.17-0.20	7.4-8.4	<4	Moderate	0.28		
	40-60	0.6-2.0	0.09-0.18	7.4-8.4	<4	Low-----	0.28		
86----- LaDelle	0-17	0.6-2.0	0.18-0.22	6.6-7.8	<2	Moderate	0.28	5	6
	17-60	0.6-2.0	0.18-0.22	7.4-8.4	<2	Moderate	0.28		
89----- Grano	0-10	0.06-0.2	0.15-0.18	7.9-8.4	<2	High-----	0.28	5	4
	10-42	0.06-0.2	0.14-0.17	7.9-8.4	<2	High-----	0.28		
	42-60	0.06-0.2	0.13-0.16	7.9-8.4	<2	High-----	0.37		
90*: Parnell-----	0-14	0.2-0.6	0.18-0.22	6.1-7.8	<2	Moderate	0.28	5	7
	14-60	0.06-0.2	0.13-0.19	6.6-7.8	<2	High-----	0.28		
Lallie-----	0-2	0.06-0.2	0.17-0.24	7.4-9.0	<8	Moderate	0.37	5	6
	2-60	0.06-0.2	0.13-0.23	7.4-9.0	<8	High-----	0.37		
91C, 91E----- Sioux	0-9	2.0-6.0	0.10-0.15	6.6-8.4	<2	Low-----	0.20	2	8
	9-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low-----	0.10		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	Mmhos/cm				
98C, 98E----- Coe	0-7	0.6-6.0	0.10-0.18	6.6-7.8	<2	Low-----	0.15	2	8
	7-60	>20	0.02-0.05	7.4-8.4	<2	Low-----	0.15		
99C----- Claire	0-5	6.0-20	0.06-0.10	6.6-7.8	<2	Low-----	0.15	5	2
	5-42	6.0-20	0.03-0.06	6.6-7.8	<2	Low-----	0.15		
	42-60	0.2-0.6	0.14-0.16	7.4-8.4	<2	Moderate--	0.37		
101----- Lallie	0-2	0.06-0.2	0.17-0.24	7.4-9.0	<8	Moderate	0.37	5	6
	2-60	0.06-0.2	0.13-0.23	7.4-9.0	<8	High-----	0.37		
104----- Lallie	0-2	0.06-0.2	0.18-0.20	7.4-9.0	4-16	Moderate	0.37	5	6
	2-60	0.06-0.2	0.10-0.19	7.4-9.0	4-16	High-----	0.37		
106----- Lallie	0-2	0.06-0.2	0.17-0.24	7.4-9.0	<8	Moderate	0.37	5	6
	2-60	0.06-0.2	0.13-0.23	7.4-9.0	<8	High-----	0.37		
107----- Minnewaukan	0-5	6.0-20	0.04-0.10	7.4-7.8	2-4	Low-----	0.15	4	2
	5-60	6.0-20	0.04-0.12	7.4-8.4	2-4	Low-----	0.15		
109*. Aqunts									
110B*: Aastad-----	0-18	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.24	5	6
	18-38	0.2-0.6	0.15-0.19	6.6-7.8	<2	Moderate	0.24		
	38-60	0.2-0.6	0.14-0.16	7.4-8.4	<2	Moderate	0.32		
Bottineau-----	0-6	0.6-2.0	0.20-0.22	6.1-6.5	<2	Moderate	0.28	5	6
	6-19	0.6-2.0	0.15-0.19	6.1-7.8	<2	Moderate	0.28		
	19-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
112F----- Edgeley Variant	0-11	0.6-2.0	0.20-0.22	6.1-7.3	<2	Low-----	0.28	4	6
	11-24	0.6-2.0	0.13-0.21	6.1-7.3	<2	Moderate	0.28		
	24-60	2.0-20	0.09-0.13	6.6-7.8	<2	Low-----	0.10		
113C, 113D----- Bottineau	0-6	0.6-2.0	0.20-0.22	6.1-6.5	<2	Moderate	0.28	5	6
	6-19	0.6-2.0	0.15-0.19	6.1-7.8	<2	Moderate	0.28		
	19-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
119----- Aberdeen	0-9	0.2-0.6	0.19-0.22	6.1-7.3	<2	Moderate	0.32	3	7
	9-26	0.06-0.2	0.13-0.18	6.6-7.8	<4	High-----	0.32		
	26-60	0.2-2.0	0.14-0.17	7.9-9.0	2-8	Low-----	0.43		
122*: Fram-----	0-13	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-----	0.28	5	4L
	13-60	0.6-2.0	0.13-0.20	7.4-8.4	<2	Low-----	0.37		
Cathay-----	0-9	0.6-2.0	0.20-0.23	6.1-7.8	<2	Low-----	0.32	3	6
	9-25	0.06-0.6	0.16-0.19	6.6-8.4	4-8	Moderate	0.32		
	25-60	0.2-0.6	0.17-0.19	7.4-9.0	4-8	Moderate	0.32		
123*, 123B*: Emrick-----	0-16	0.6-2.0	0.20-0.24	6.6-7.3	<2	Low-----	0.28	5	5
	16-34	0.6-2.0	0.17-0.19	6.6-7.3	<2	Low-----	0.28		
	34-60	0.6-6.0	0.11-0.21	7.4-8.4	<2	Low-----	0.37		
Cathay-----	0-9	0.6-2.0	0.20-0.23	6.1-7.8	<2	Low-----	0.32	3	6
	9-25	0.06-0.6	0.16-0.19	6.6-8.4	4-8	Moderate	0.32		
	25-60	0.2-0.6	0.17-0.19	7.4-9.0	4-8	Moderate	0.32		
124C*: Heimdal-----	0-8	0.6-2.0	0.20-0.24	6.6-7.3	<2	Low-----	0.28	5	5
	8-19	0.6-2.0	0.17-0.19	6.6-7.8	<2	Low-----	0.28		
	19-60	0.6-6.0	0.11-0.21	7.9-8.4	<2	Low-----	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	Mmhos/cm				
Sioux-----	0-9	0.6-2.0	0.18-0.20	6.6-8.4	<2	Low-----	0.28	2	8
	9-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low-----	0.10		
125C*: Heimdal-----	0-8	0.6-2.0	0.20-0.24	6.6-7.3	<2	Low-----	0.20	5	8
	8-19	0.6-2.0	0.17-0.19	6.6-7.8	<2	Low-----	0.32		
	19-60	0.6-6.0	0.11-0.21	7.9-8.4	<2	Low-----	0.32		
Emrick-----	0-16	0.6-2.0	0.20-0.24	6.6-7.3	<2	Low-----	0.20	5	8
	16-34	0.6-2.0	0.17-0.19	6.6-7.3	<2	Low-----	0.28		
	34-60	0.6-6.0	0.11-0.21	7.4-8.4	<2	Low-----	0.37		
125F*: Heimdal-----	0-8	0.6-2.0	0.20-0.24	6.6-7.3	<2	Low-----	0.20	5	8
	8-19	0.6-2.0	0.17-0.19	6.6-7.8	<2	Low-----	0.32		
	19-60	0.6-6.0	0.11-0.21	7.9-8.4	<2	Low-----	0.32		
Esmond-----	0-9	0.6-2.0	0.20-0.22	7.4-7.8	<2	Low-----	0.20	5	5
	9-60	0.6-2.0	0.14-0.22	7.9-8.4	<2	Low-----	0.37		
126----- Fram	0-13	0.6-2.0	0.20-0.24	7.4-8.4	4-16	Low-----	0.28	5	4L
	13-60	0.6-6.0	0.13-0.20	7.4-8.4	4-16	Low-----	0.37		
127----- Fram	0-13	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-----	0.28	5	4L
	13-60	0.6-2.0	0.13-0.20	7.4-8.4	<2	Low-----	0.37		
129*: Colvin-----	0-12	0.6-2.0	0.13-0.18	7.4-9.0	4-16	Moderate	0.32	5	4L
	12-60	0.2-2.0	0.13-0.18	7.4-9.0	4-16	High-----	0.32		
Borup-----	0-12	2.0-6.0	0.13-0.15	7.4-8.4	4-16	Low-----	0.28	5	4L
	12-30	2.0-6.0	0.11-0.13	7.9-8.4	4-16	Low-----	0.28		
	30-60	2.0-20	0.09-0.13	7.9-8.4	4-16	Low-----	0.28		
131D----- Miranda Variant	0-1	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low-----	0.32	1	8
	1-42	---	---	---	---	---	---		
	42-60	<0.06	0.13-0.17	7.9-9.0	4-16	Moderate	0.32		
133----- Fordville	0-7	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low-----	0.24	4	6
	7-24	0.6-2.0	0.18-0.21	6.1-7.8	<2	Moderate	0.24		
	24-60	6.0-20	0.03-0.06	7.4-8.4	---	Low-----	---		
134*: Borup-----	0-12	2.0-6.0	0.20-0.23	7.4-8.4	<2	Low-----	0.28	5	4L
	12-30	2.0-6.0	0.17-0.20	7.4-8.4	<2	Low-----	0.28		
	30-60	2.0-20	0.15-0.19	7.9-8.4	<2	Low-----	0.28		
Vallers-----	0-9	0.6-2.0	0.22-0.24	7.4-8.4	<2	Low-----	0.28	5	4L
	9-22	0.2-0.6	0.15-0.19	7.9-8.4	<2	Moderate	0.28		
	22-60	0.2-0.6	0.17-0.19	7.4-8.4	<2	Low-----	0.28		
135*: Miranda-----	0-5	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low-----	0.32	1	8
	5-22	<0.06	0.14-0.18	6.6-8.4	2-8	Moderate	0.32		
	22-60	<0.06	0.13-0.17	7.9-9.0	4-16	Moderate	0.32		
Larson-----	0-7	0.6-2.0	0.16-0.24	6.1-7.3	<2	Moderate	0.32	3	5
	7-20	0.06-0.2	0.10-0.14	7.4-9.0	4-16	Moderate	0.32		
	20-60	0.2-2.0	0.12-0.16	7.9-9.0	2-8	Moderate	0.32		
137----- Stirum	0-9	2.0-6.0	0.06-0.12	7.9-8.4	2-4	Low-----	0.17	3	2
	9-18	0.2-0.6	0.12-0.18	<7.9	2-8	Low-----	0.32		
	18-60	0.6-20	0.06-0.18	<7.9	2-8	Low-----	0.17		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	Mmhos/cm				
140B*:									
Svea-----	0-12	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low-----	0.28	5	6
	12-22	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28		
	22-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Buse-----	0-8	0.2-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	4L
	8-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
141*:									
Emlden-----	0-12	2.0-6.0	0.13-0.18	6.6-7.3	<2	Low-----	0.20	5	3
	12-34	2.0-6.0	0.12-0.17	6.6-7.8	<2	Low-----	0.20		
	34-60	2.0-6.0	0.06-0.16	7.9-8.4	<2	Low-----	0.20		
Letcher-----	0-10	0.6-2.0	0.11-0.20	5.1-7.8	<2	Low-----	0.24	3	3
	10-23	0.06-0.2	0.08-0.12	6.6-8.4	2-8	Low-----	0.24		
	23-39	0.06-0.2	0.16-0.19	7.9-8.4	2-8	Moderate	0.24		
	39-60	2.0-6.0	0.06-0.10	8.5-9.0	2-8	Low-----	0.24		
144*, 144B*:									
Hamerly-----	0-9	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.28	5	4L
	9-22	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
	22-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Cresbard-----	0-8	0.6-2.0	0.17-0.20	5.6-6.5	<2	Low-----	0.32	3	6
	8-16	0.06-0.6	0.11-0.14	6.1-8.4	2-4	High-----	0.32		
	16-60	0.2-0.6	0.11-0.15	7.4-9.0	2-8	High-----	0.32		
145-----	0-10	0.06-0.2	0.15-0.18	7.9-8.4	4-16	High-----	0.28	5	4L
Grano	10-42	0.06-0.2	0.13-0.17	7.9-8.4	4-16	High-----	0.37		
146*:									
Hamerly-----	0-9	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.28	5	4L
	9-22	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
	22-60	0.2-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Tonka-----	0-22	0.6-2.0	0.18-0.23	5.6-6.5	<2	Low-----	0.32	5	6
	22-38	0.06-0.2	0.14-0.19	5.6-7.3	<2	High-----	0.43		
	38-60	0.2-0.6	0.14-0.19	6.6-9.0	<2	Moderate	0.43		
149B-----	0-21	6.0-20	0.08-0.12	6.6-7.8	<2	Low-----	0.17	5	2
Maddock	21-60	6.0-20	0.05-0.13	6.6-8.4	<2	Low-----	0.17		
150*.									
Pits									

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
3----- Parnell	C/D	Frequent----	Long-----	Apr-Nov	0-2.0	Apparent	Jan-Dec	High-----	High-----	Low.
4----- Fargo	D	Rare-----	Brief-----	Sep-Jun	0-3.0	Apparent	Sep-Jun	High-----	High-----	Low.
5----- Hegne	D	None-----	---	---	0-1.0	Apparent	Apr-Jul	Moderate	High-----	Low.
7----- Colvin	C/D	None to common.	Long-----	Apr-Jun	0-1.0	Apparent	Apr-Jun	High-----	High-----	Low.
8----- Colvin	C/D	Frequent----	Long-----	Apr-Jun	0-1.0	Apparent	Apr-Jun	High-----	High-----	Low.
9----- Rauville	D	Frequent----	Brief-----	Mar-Oct	0-2.0	Apparent	Jan-Dec	High-----	High-----	Moderate.
11*: Svea-----	B	None-----	---	---	4.0-6.0	Apparent	Apr-Jun	Moderate	High-----	Low.
Barnes-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
12B*: Barnes-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
Svea-----	B	None-----	---	---	4.0-6.0	Apparent	Apr-Jun	Moderate	High-----	Low.
13C*, 13D*: Barnes-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
Buse-----	B	None-----	---	---	>6.0	---	---	Moderate	Low-----	Low.
14*, 14B*: Svea-----	B	None-----	---	---	4.0-6.0	Apparent	Apr-Jun	Moderate	High-----	Low.
Hamerly-----	C	None-----	---	---	1.5-3.0	Apparent	Sep-Jun	High-----	High-----	Low.
15----- Vallars	C	Rare-----	---	---	0-1.0	Apparent	Apr-Jul	High-----	High-----	Moderate.
16----- Vallars	C	Rare-----	---	---	1.0-2.5	Apparent	Nov-Jun	High-----	High-----	Low.
18E----- Buse	B	None-----	---	---	>6.0	---	---	Moderate	Low-----	Low.
19----- Tonka	C/D	Frequent----	Long-----	Apr-Jun	0-1.0	Apparent	Sep-Jun	High-----	High-----	Low.
21*: Emrick-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
Heimdal-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
22B*: Heimdal-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
Emrick-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
23C*: Heimdal-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
Esmond-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					<u>Ft</u>					
24*: Fram-----	B	None-----	---	---	2.0-6.0	Apparent	Sep-Jun	High-----	High-----	Low.
Emrick-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
25D*, 25E*: Esmond-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
Heimdal-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
26E*: Esmond-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
Sioux-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Low.
27C*, 28D*: Barnes-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
Sioux-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Low.
30D*: Barnes-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
Buse-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Moderate.
31B----- Towner	B	None-----	---	---	3.0-6.0	Perched	Apr-Jun	Moderate	High-----	Low.
33C----- Dickey	B	None-----	---	---	>6.0	---	---	Low-----	High-----	Low.
34*, 34B*, 34C*: Embsen-----	B	None-----	---	---	3.5-6.0	Apparent	Apr-Jun	Moderate	High-----	Low.
Heimdal-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
41----- Overly	C	None-----	---	---	>6.0	---	---	High-----	High-----	Low.
42----- Gardena	B	None-----	---	---	4.0-6.0	Apparent	Apr-Jun	High-----	Moderate	Low.
42B*: Gardena-----	B	None-----	---	---	4.0-6.0	Apparent	Apr-Jun	High-----	Moderate	Low.
Eckman-----	B	None-----	---	---	>6.0	---	---	High-----	Moderate	Low.
43C*: Eckman-----	B	None-----	---	---	>6.0	---	---	High-----	Moderate	Low.
Zell-----	B	None-----	---	---	>6.0	---	---	High-----	High-----	Moderate.
44----- Glyndon	B	None-----	---	---	2.5-6.0	Apparent	Apr-Jul	High-----	High-----	Low.
45----- Bearden	C	None-----	---	---	1.5-2.5	Apparent	Sep-Jun	High-----	High-----	Low.
46----- Borup	B/D	None-----	---	---	0-3.0	Apparent	Apr-Jul	High-----	High-----	Low.
47----- Fossum	A/D	Occasional	Brief-----	Apr-Jul	0-1.0	Apparent	Nov-Oct	Moderate	High-----	Low.
50B----- Great Bend	B	None-----	---	---	>6.0	---	---	High-----	High-----	Moderate.
52B*: Embsen-----	B	None-----	---	---	3.5-6.0	Apparent	Apr-Jun	Moderate	High-----	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth Ft	Kind	Months		Uncoated steel	Concrete
52B*: Egeland-----	B	None-----	---	---	>6.0	---	---	Low-----	Moderate	Low.
53----- Hecla	A	None-----	---	---	3.0-6.0	Apparent	Apr-Oct	Moderate	Moderate	Low.
54B*, 58*: Hecla-----	A	None-----	---	---	3.0-6.0	Apparent	Apr-Oct	Moderate	Moderate	Low.
Maddock-----	A	None-----	---	---	>6.0	---	---	Low-----	Moderate	Low.
59B*: Maddock-----	A	None-----	---	---	>6.0	---	---	Low-----	Moderate	Low.
Hecla-----	A	None-----	---	---	3.0-6.0	Apparent	Apr-Oct	Moderate	Moderate	Low.
59D----- Maddock	A	None-----	---	---	>6.0	---	---	Low-----	Moderate	Low.
61, 61B----- Renshaw	B	None-----	---	---	>6.0	---	---	Low-----	Moderate	Low.
63, 63B, 63C----- Brantford	B	None-----	---	---	>6.0	---	---	Low-----	Moderate	Low.
64----- Divide	B	None-----	---	---	2.5-5.0	Apparent	Sep-Jun	Moderate	High-----	Low.
65, 65B----- Vang	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
66, 67----- Marysland	B/D	Rare-----	---	---	0-1.0	Apparent	Nov-Jul	High-----	High-----	Low.
68B----- Arvilla	A	None-----	---	---	>6.0	---	---	Low-----	Moderate	Low.
70B----- Binford	B	None-----	---	---	>6.0	---	---	Low-----	Moderate	Low.
71*, 71B*: Svea-----	B	None-----	---	---	4.0-6.0	Apparent	Apr-Jun	Moderate	High-----	Low.
Cresbard-----	C	None-----	---	---	>6.0	---	---	Moderate	High-----	Moderate.
73*: Larson-----	D	None-----	---	---	3.0-6.0	Apparent	Mar-Jun	Moderate	High-----	Moderate.
Cathay-----	C	None-----	---	---	3.0-5.0	Apparent	Apr-Jun	Moderate	High-----	Moderate.
74B*: Cavour-----	D	None-----	---	---	>6.0	---	---	Moderate	High-----	Moderate.
Miranda-----	D	None-----	---	---	>6.0	---	---	Moderate	High-----	Moderate.
75----- Ryan	D	Occasional	Brief to long.	Mar-Jun	0-1.0	Apparent	Sep-Jun	Moderate	High-----	Moderate.
78*: LaDelle-----	B	Rare-----	Brief-----	Apr-Jun	4.0-6.0	Apparent	Oct-Jun	High-----	High-----	Low.
Aberdeen-----	D	None-----	---	---	4.0-6.0	Apparent	Apr-Jun	Moderate	High-----	Moderate.
82B----- Darnen	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
83----- LaDelle	B	Rare-----	Brief-----	Apr-Jun	4.0-6.0	Apparent	Oct-Jun	High-----	High-----	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth Ft	Kind	Months		Uncoated steel	Concrete
85----- Lamoure	C	Frequent----	Brief-----	Mar-Oct	0-2.0	Apparent	Oct-Jun	High-----	High-----	Moderate.
86----- LaDelle	B	Frequent----	Brief-----	Apr-Jun	4.0-6.0	Apparent	Oct-Jun	High-----	High-----	Low.
89----- Grano	D	Occasional	Long-----	Sep-Jun	0-1.0	Apparent	Sep-Jun	High-----	High-----	Low.
90*: Parnell-----	C/D	Frequent----	Very long	Jan-Dec	+2-1.0	Apparent	Jan-Dec	High-----	High-----	Low.
Lallie-----	D	Frequent----	Long-----	Apr-Jun	0-1.0	Apparent	Sep-Jun	High-----	High-----	Moderate.
91C, 91E----- Sioux	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Low.
98C, 98E----- Coe	A	None-----	---	---	>6.0	---	---	Low-----	Moderate	Low.
99C----- Claire	A	None-----	---	---	>6.0	---	---	Low-----	Moderate	Low.
101----- Lallie	D	Frequent----	Long-----	Apr-Jun	0-1.0	Apparent	Sep-Jun	High-----	High-----	Moderate.
104----- Lallie	D	Frequent----	Long-----	Apr-Jun	0-1.0	Apparent	Apr-Jun	High-----	High-----	Low.
106----- Lallie	D	Frequent----	Long-----	Apr-Jun	0-1.0	Apparent	Sep-Jun	High-----	High-----	Moderate.
107----- Minnewaukan	A/D	Occasional	Long-----	Apr-Jun	0-2.0	Apparent	Mar-Jul	Moderate	High-----	Low.
109*. Aqvents										
110B*: Aastad-----	B	None-----	---	---	3.0-6.0	Apparent	Mar-Jun	Moderate	High-----	Low.
Bottineau-----	C	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
112F----- Edgeley Variant	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
113C, 113D----- Bottineau	C	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
119----- Aberdeen	D	None-----	---	---	4.0-6.0	Apparent	Apr-Jun	Moderate	High-----	Moderate.
122*: Fram-----	B	None-----	---	---	2.0-6.0	Apparent	Sep-Jun	High-----	High-----	Low.
Cathay-----	C	None-----	---	---	3.0-5.0	Apparent	Apr-Jun	Moderate	High-----	Moderate.
123*, 123B*: Emrick-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
Cathay-----	C	None-----	---	---	3.0-5.0	Apparent	Apr-Jun	Moderate	High-----	Moderate.
124C*: Heimdal-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
Sioux-----	A	None-----	---	---	>6.0	---	---	Low-----	Low-----	Low.
125C*: Heimdal-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					<u>Ft</u>					
125C*: Emrick-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
125F*: Heimdal-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
Esmond-----	B	None-----	---	---	>6.0	---	---	Moderate	High-----	Low.
126----- Fram	B	None-----	---	---	2.0-4.0	Apparent	Sep-Jun	High-----	High-----	Low.
127----- Fram	B	None-----	---	---	2.0-6.0	Apparent	Sep-Jun	High-----	High-----	Low.
129*: Colvin-----	C	Frequent----	Long-----	Apr-Jun	0-2.0	Apparent	Sep-Jun	High-----	High-----	Moderate.
Borup-----	B/D	Rare-----	---	---	0-1.0	Apparent	Apr-Jul	High-----	High-----	Moderate.
131D----- Miranda Variant	D	None-----	---	---	>6.0	---	---	Moderate	High-----	Moderate.
133----- Fordville	B	None-----	---	---	>6.0	---	---	Low-----	Moderate	Low.
134*: Borup-----	B/D	None-----	---	---	0-3.0	Apparent	Apr-Jul	High-----	High-----	Low.
Vallers-----	C	Rare-----	---	---	1.0-2.5	Apparent	Nov-Jun	High-----	High-----	Low.
135*: Miranda-----	D	None-----	---	---	>6.0	---	---	Moderate	High-----	Moderate.
Larson-----	D	None-----	---	---	3.0-6.0	Apparent	Mar-Jun	Moderate	High-----	Moderate.
137----- Stirum	B/D	Frequent----	Very long	Apr-Jun	0-1.0	Apparent	Apr-Jul	Moderate	High-----	Moderate.
140B*: Svea-----	B	None-----	---	---	4.0-6.0	Apparent	Apr-Jun	Moderate	High-----	Low.
Buse-----	B	None-----	---	---	>6.0	---	---	Moderate	Low-----	Low.
141*: Embden-----	B	None-----	---	---	3.5-6.0	Apparent	Apr-Jun	Moderate	High-----	Low.
Letcher-----	D	None-----	---	---	3.0-6.0	Apparent	Nov-Jun	Moderate	High-----	Moderate.
144*, 144B*: Hamerly-----	C	None-----	---	---	1.5-3.0	Apparent	Sep-Jun	High-----	High-----	Low.
Cresbard-----	C	None-----	---	---	>6.0	---	---	Moderate	High-----	Moderate.
145----- Grano	D	Occasional	Long-----	Sep-Jun	0-2.0	Apparent	Sep-Jun	High-----	High-----	Low.
146*: Hamerly-----	C	None-----	---	---	1.5-3.0	Apparent	Sep-Jun	High-----	High-----	Low.
Tonka-----	C/D	Frequent----	Long-----	Apr-Jun	0-1.0	Apparent	Sep-Jun	High-----	High-----	Low.
149B----- Maddock	A	None-----	---	---	>6.0	---	---	Low-----	Moderate	Low.
150*. Pits										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

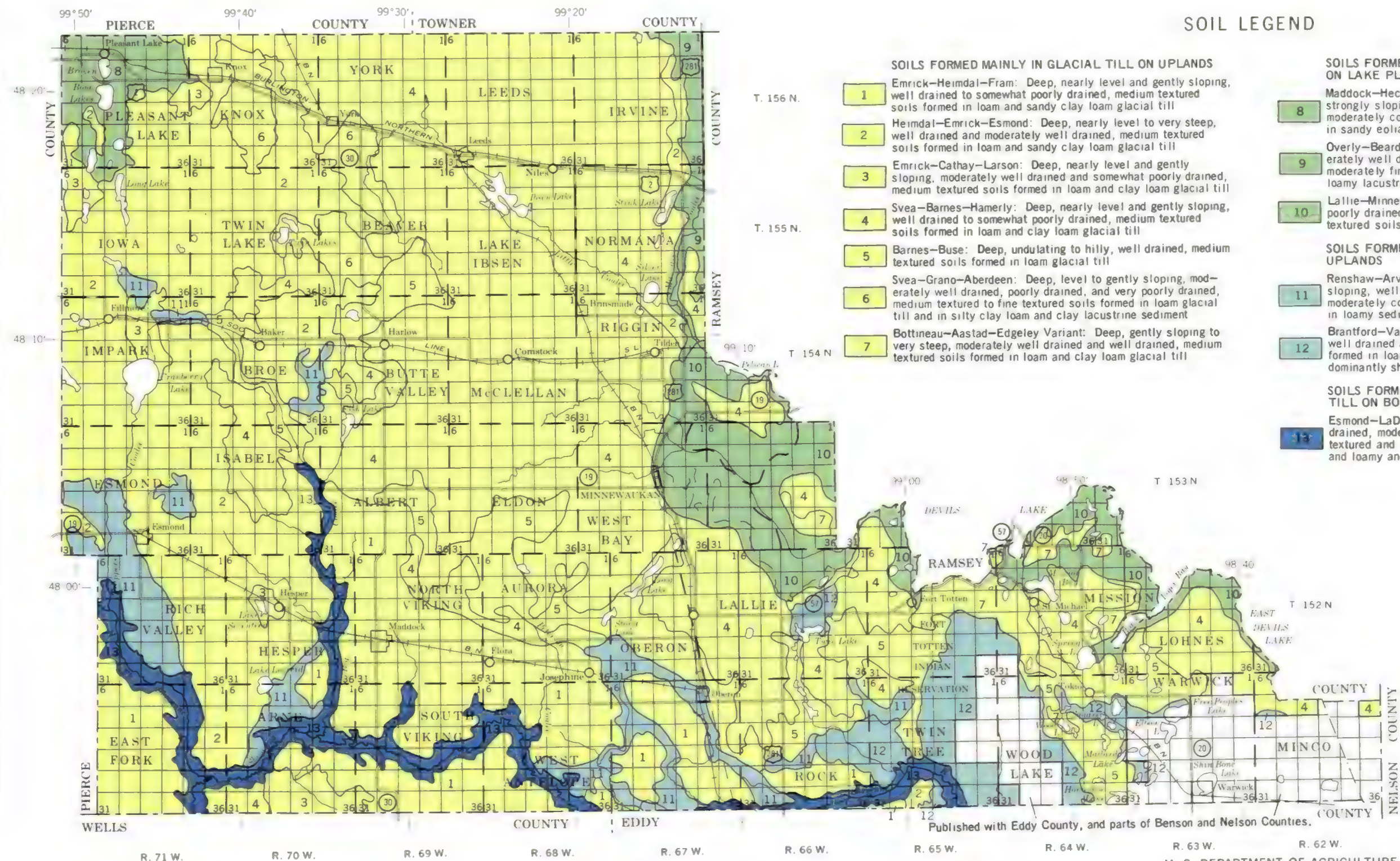
[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Aastad-----	Fine-loamy, mixed Pachic Udic Haploborolls
Aberdeen-----	Fine, montmorillonitic Glossic Udic Natriborolls
Aquents-----	Fine and loamy, montmorillonitic and mixed, frigid Aquents
Arvilla-----	Sandy, mixed Udic Haploborolls
Barnes-----	Fine-loamy, mixed Udic Haploborolls
Bearden-----	Fine-silty, frigid Aeric Calciaquolls
Binford-----	Sandy, mixed Udic Haploborolls
Borup-----	Coarse-silty, frigid Typic Calciaquolls
Bottineau-----	Fine-loamy, mixed Udic Argiborolls
Brantford-----	Fine-loamy over sandy or sandy-skeletal, mixed Udic Haploborolls
Buse-----	Fine-loamy, mixed Udorthentic Haploborolls
*Cathay-----	Fine-loamy, mixed Glossic Udic Natriborolls
Cavour-----	Fine, montmorillonitic Udic Natriborolls
*Claire-----	Mixed, frigid Typic Udipsamments
Coe-----	Sandy-skeletal, mixed Udorthentic Haploborolls
Colvin-----	Fine-silty, frigid Typic Calciaquolls
*Cresbard-----	Fine, montmorillonitic Glossic Udic Natriborolls
Darnen-----	Fine-loamy, mixed Pachic Udic Haploborolls
Dickey-----	Sandy over loamy, mixed Udorthentic Haploborolls
Divide-----	Fine-loamy over sandy or sandy-skeletal, frigid Aeric Calciaquolls
Eckman-----	Coarse-silty, mixed Udic Haploborolls
Edgeley Variant-----	Loamy-skeletal, mixed Udic Haploborolls
Egeland-----	Coarse-loamy, mixed Udic Haploborolls
Emdben-----	Coarse-loamy, mixed Pachic Udic Haploborolls
Emrick-----	Coarse-loamy, mixed Pachic Udic Haploborolls
Esmond-----	Coarse-loamy, mixed Udorthentic Haploborolls
*Fargo-----	Fine, montmorillonitic, frigid Vertic Haplaquolls
Fordville-----	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls
Fossum-----	Sandy, mixed, frigid Typic Haplaquolls
Fram-----	Coarse-loamy, frigid Aeric Calciaquolls
Gardena-----	Coarse-silty, mixed Pachic Udic Haploborolls
Glyndon-----	Coarse-silty, frigid Aeric Calciaquolls
Grano-----	Fine, montmorillonitic (calcareous), frigid Vertic Haplaquolls
Great Bend-----	Fine-silty, mixed Udic Haploborolls
Hamerly-----	Fine-loamy, frigid Aeric Calciaquolls
Hecla-----	Sandy, mixed Aquic Haploborolls
Hegne-----	Fine, frigid Typic Calciaquolls
Heimdal-----	Coarse-loamy, mixed Udic Haploborolls
LaDelle-----	Fine-silty, mixed Cumulic Udic Haploborolls
Lallie-----	Fine, montmorillonitic (calcareous), frigid Typic Fluvaquents
*Lamoure-----	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Larson-----	Fine-loamy, mixed Udic Natriborolls
Letcher-----	Coarse-loamy, mixed Udic Natriborolls
Maddock-----	Sandy, mixed Udorthentic Haploborolls
Marysland-----	Fine-loamy over sandy or sandy-skeletal, frigid Typic Calciaquolls
Minnewaukan-----	Mixed, frigid Typic Psammaquents
Miranda-----	Fine-loamy, mixed Leptic Natriborolls
Miranda Variant-----	Fine, montmorillonitic Leptic Natriborolls
Overly-----	Fine-silty, mixed Pachic Udic Haploborolls
Parnell-----	Fine, montmorillonitic, frigid Typic Argiaquolls
Rauville-----	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Renshaw-----	Fine-loamy over sandy or sandy-skeletal, mixed Udic Haploborolls
Ryan-----	Fine, montmorillonitic, frigid Typic Natraquolls
Sioux-----	Sandy-skeletal, mixed Udorthentic Haploborolls
Stirum-----	Coarse-loamy, mixed, frigid Typic Natraquolls
Svea-----	Fine-loamy, mixed Pachic Udic Haploborolls
*Tonka-----	Fine, montmorillonitic, frigid Argiaquic Argialbolls
Towner-----	Sandy over loamy, mixed Udorthentic Haploborolls
Vallers-----	Fine-loamy, frigid Typic Calciaquolls
Vang-----	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls
Zell-----	Coarse-silty, mixed Udorthentic Haploborolls

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SOIL LEGEND

- SOILS FORMED MAINLY IN GLACIAL TILL ON UPLANDS**
- 1 Emrick-Heimdal-Fram: Deep, nearly level and gently sloping, well drained to somewhat poorly drained, medium textured soils formed in loam and sandy clay loam glacial till
 - 2 Heimdal-Emrick-Esmond: Deep, nearly level to very steep, well drained and moderately well drained, medium textured soils formed in loam and sandy clay loam glacial till
 - 3 Emrick-Cathay-Larson: Deep, nearly level and gently sloping, moderately well drained and somewhat poorly drained, medium textured soils formed in loam and clay loam glacial till
 - 4 Svea-Barnes-Hamerly: Deep, nearly level and gently sloping, well drained to somewhat poorly drained, medium textured soils formed in loam and clay loam glacial till
 - 5 Barnes-Buse: Deep, undulating to hilly, well drained, medium textured soils formed in loam glacial till
 - 6 Svea-Grano-Aberdeen: Deep, level to gently sloping, moderately well drained, poorly drained, and very poorly drained, medium textured to fine textured soils formed in loam glacial till and in silty clay loam and clay lacustrine sediment
 - 7 Bottineau-Aastad-Edgeley Variant: Deep, gently sloping to very steep, moderately well drained and well drained, medium textured soils formed in loam and clay loam glacial till
- SOILS FORMED IN LACUSTRINE AND EOLIAN SEDIMENT ON LAKE PLAINS**
- 8 Maddock-Hecla-Emden: Deep, nearly level to rolling or strongly sloping, well drained and moderately well drained, moderately coarse textured and coarse textured soils formed in sandy eolian or outwash materials and lacustrine sediment
 - 9 Overly-Bearden-Fargo: Deep, level to gently sloping, moderately well drained to poorly drained, medium textured and moderately fine textured soils formed in silty, clayey, and loamy lacustrine sediment
 - 10 Lallie-Minnewaukan: Deep, level and nearly level, very poorly drained and poorly drained, coarse textured and medium textured soils formed in clayey and sandy lacustrine sediment
- SOILS FORMED IN GLACIAL OUTWASH ON TERRACES AND UPLANDS**
- 11 Renshaw-Arvilla-Fordville: Deep, nearly level and gently sloping, well drained and somewhat excessively drained, moderately coarse textured and medium textured soils formed in loamy sediment over sand and gravel
 - 12 Brantford-Vang-Coe: Deep, nearly level to moderately steep, well drained and excessively drained, medium textured soils formed in loamy sediment over sand and gravel that is predominantly shale
- SOILS FORMED IN ALLUVIAL SEDIMENT AND GLACIAL TILL ON BOTTOM LANDS AND ADJACENT UPLANDS**
- 13 Esmond-LaDelle-Ryan: Deep, level to very steep, poorly drained, moderately well drained, and well drained, medium textured and fine textured soils formed in loam glacial till and loamy and clayey alluvium

Compiled 1978

Published with Eddy County, and parts of Benson and Nelson Counties.

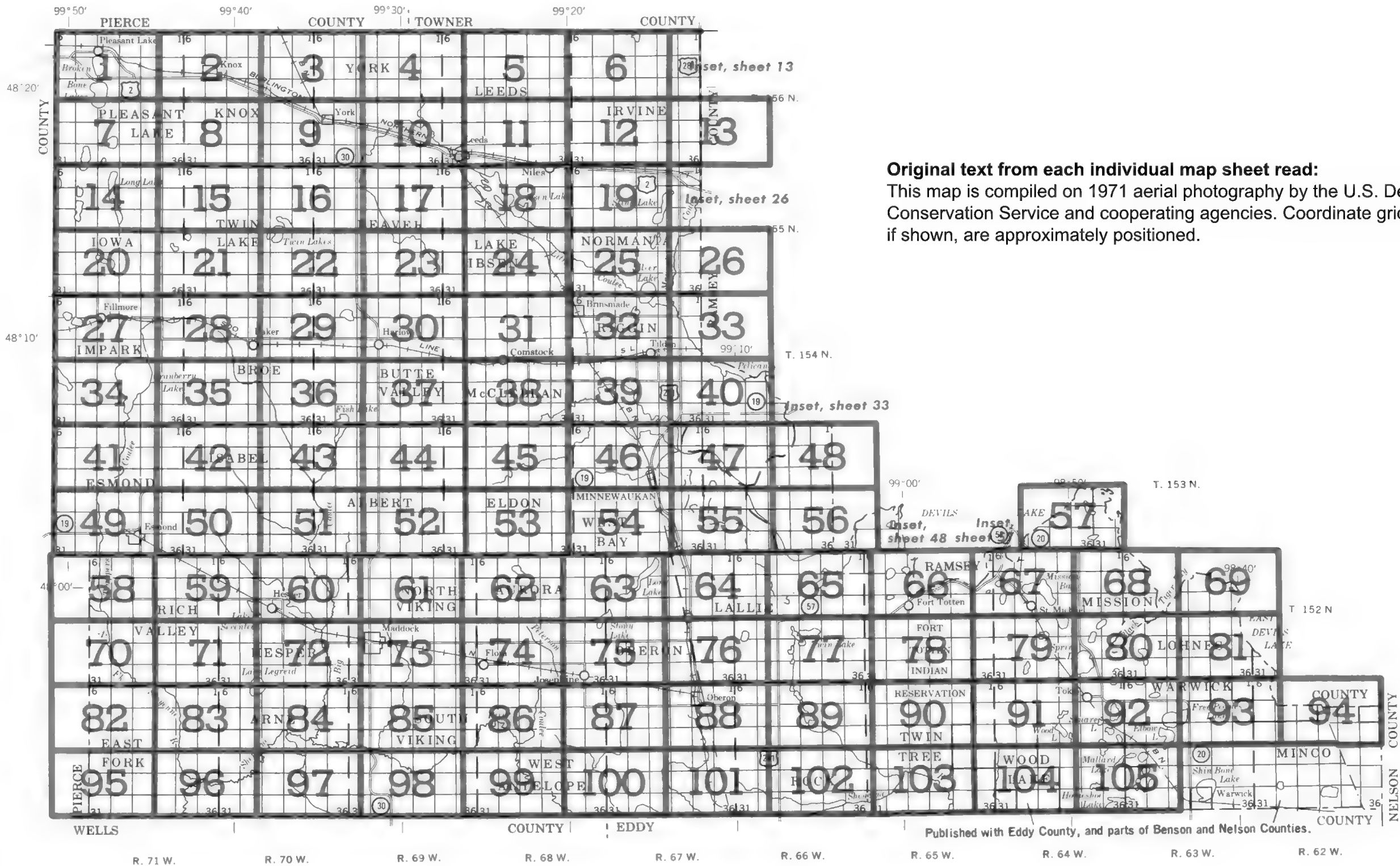
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS
NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP BENSON COUNTY AREA, NORTH DAKOTA

Scale 1:316,800
1 0 1 2 3 4 5 Miles

SECTIONALIZED TOWNSHIP					
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS BENSON COUNTY AREA, NORTH DAKOTA

Scale 1:316,800
 1 0 1 2 3 4 5 Miles

SECTIONALIZED TOWNSHIP					
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
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30	29	28	27	26	25
31	32	33	34	35	36

CONVENTIONAL AND SPECIAL
SYMBOLS LEGEND

SOIL LEGEND

Symbols consist of numbers or a combination of numbers and letters; for example, 45, 63, 110B, and 125C. The number designates the kind of soil or miscellaneous area. The letters B, C, D, E, and F following the numbers indicate the class of slope. Symbols without a slope letter are used for level or nearly level soils. The soil names listed without a slope designation are for level (0 to 1 percent) soils. The miscellaneous areas and units named at a category above the series level are listed without a slope designation and may have a considerable range of slope.

SYMBOL	NAME	SYMBOL	NAME
3	Parnell silty clay loam	66	Marysland loam
4	Fargo silty clay loam	67	Marysland loam, wet
5	Hegne silty clay	68B	Arvilla sandy loam, 1 to 6 percent slopes
7	Colvin silt loam	70B	Binford sandy loam, 1 to 6 percent slopes
8	Colvin silt loam, wet	71	Svea-Cresbard loams, 1 to 3 percent slopes
9	Rauville silt loam	71B	Svea-Cresbard loams, 3 to 6 percent slopes
11	Svea-Barnes loams, 1 to 3 percent slopes	73	Larson-Cathay loams, 1 to 3 percent slopes
12B	Barnes-Svea loams, 3 to 6 percent slopes	74B	Cavour-Miranda complex, 1 to 6 percent slopes
13C	Barnes-Buse loams, 6 to 9 percent slopes	75	Ryan silty clay
13D	Barnes-Buse loams, 9 to 15 percent slopes	78	LaDelle-Aberdeen silt loams
14	Svea-Hamerly loams, 1 to 3 percent slopes	82B	Darnen loam, 3 to 6 percent slopes
14B	Svea-Hamerly loams, 3 to 6 percent slopes	83	LaDelle silt loam
15	Vallers loam, saline, 1 to 3 percent slopes	85	Lamoure silt loam
16	Vallers loam	86	LaDelle silt loam, channeled
18E	Buse loam, 15 to 25 percent slopes	89	Grano silty clay
19	Tonka silt loam	90	Parnell and Lallie soils, ponded
21	Emrick-Heimdal loams, 1 to 3 percent slopes	91C	Sioux gravelly loam, 1 to 9 percent slopes
22B	Heimdal-Emrick loams, 3 to 6 percent slopes	91E	Sioux gravelly loam, 9 to 25 percent slopes
23C	Heimdal-Esmond loams, 6 to 9 percent slopes	98C	Coe shaly loam, 1 to 9 percent slopes
24	Fram-Emrick loams, 1 to 3 percent slopes	98E	Coe shaly loam, 9 to 25 percent slopes
25D	Esmond-Heimdal loams, 9 to 15 percent slopes	99C	Claire loamy coarse sand, loamy substratum, 1 to 9 percent slopes
25E	Esmond-Heimdal loams, 15 to 25 percent slopes	101	Lallie loam
26E	Esmond-Sioux loams, 9 to 25 percent slopes	104	Lallie loam, saline
27C	Barnes-Sioux loams, 3 to 9 percent slopes	106	Lallie loam, wet
28D	Barnes-Sioux loams, 9 to 15 percent slopes	107	Minnewaukan loamy fine sand, 1 to 3 percent slopes
30D	Barnes-Buse very stony loams, 6 to 25 percent slopes	109	Aquents
31B	Towner fine sandy loam, 1 to 6 percent slopes	110B	Aastad-Bottineau loams, 3 to 6 percent slopes
33C	Dickey fine sandy loam, 6 to 9 percent slopes	112F	Edgeley Variant loam, 15 to 60 percent slopes
34	Embsen-Heimdal complex, 1 to 3 percent slopes	113C	Bottineau loam, 6 to 9 percent slopes
34B	Embsen-Heimdal complex, 3 to 6 percent slopes	113D	Bottineau loam, 9 to 15 percent slopes
34C	Embsen-Heimdal complex, 6 to 9 percent slopes	119	Aberdeen silty clay loam
41	Overly silty clay loam, 1 to 3 percent slopes	122	Fram-Cathay loams, 1 to 3 percent slopes
42	Gardena silt loam, 1 to 3 percent slopes	123	Emrick-Cathay loams, 1 to 3 percent slopes
42B	Gardena-Eckman silt loams, 3 to 6 percent slopes	123B	Emrick-Cathay loams, 3 to 6 percent slopes
43C	Eckman-Zell silt loams, 6 to 9 percent slopes	124C	Heimdal-Sioux loams, 3 to 9 percent slopes
44	Glyndon silt loam	125C	Heimdal-Emrick very stony loams, 1 to 9 percent slopes
45	Bearden silt loam	125F	Heimdal-Esmond very stony loams, 9 to 40 percent slopes
46	Borup silt loam	126	Fram loam, saline, 1 to 3 percent slopes
47	Fossum fine sandy loam	127	Fram loam, 1 to 3 percent slopes
50B	Great Bend silt loam, 3 to 6 percent slopes	129	Colvin and Borup silt loams, saline
52B	Embsen-Egeland fine sandy loams, 1 to 6 percent slopes	131D	Miranda Variant loam, 3 to 15 percent slopes
53	Hecla fine sandy loam, 1 to 3 percent slopes	133	Fordville loam, 1 to 3 percent slopes
54B	Hecla-Maddock fine sandy loams, 3 to 6 percent slopes	134	Borup-Vallers complex, 1 to 3 percent slopes
58	Hecla-Maddock loamy fine sands, 1 to 3 percent slopes	135	Miranda-Larson complex, 1 to 3 percent slopes
59B	Maddock-Hecla loamy fine sands, 3 to 6 percent slopes	137	Strum loamy fine sand
59D	Maddock loamy fine sand, 6 to 15 percent slopes	140B	Svea-Buse loams, 3 to 6 percent slopes
61	Renshaw loam, 1 to 3 percent slopes	141	Embsen-Letcher fine sandy loams, 1 to 3 percent slopes
61B	Renshaw loam, 3 to 6 percent slopes	144	Hamerly-Cresbard loams, 1 to 3 percent slopes
63	Brantford loam, 1 to 3 percent slopes	144B	Hamerly-Cresbard loams, 3 to 6 percent slopes
63B	Brantford loam, 3 to 6 percent slopes	145	Grano silty clay, saline
63C	Brantford loam, 6 to 9 percent slopes	146	Hamerly-Tonka loams, 0 to 3 percent slopes
64	Divide loam, 1 to 3 percent slopes	149B	Maddock loamy fine sand, 1 to 6 percent slopes
65	Vang loam, 1 to 3 percent slopes	150	Pits, gravel
65B	Vang loam, 3 to 6 percent slopes		

CULTURAL FEATURES

BOUNDARIES

National, state or province	
County or parish	
Minor civil division	
Reservation (national forest or park, state forest or park, and large airport)	
Land grant	
Limit of soil survey (label)	
Field sheet matchline & neatline	

AD HOC BOUNDARY (label)

Small airport, airfield, park, oilfield, cemetery, or flood pool	
--	--

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)	
--	--

ROADS

Divided (median shown if scale permits)	
Other roads	
Trail	

ROAD EMBLEMS & DESIGNATIONS

Interstate	
Federal	
State	
County, farm or ranch	

RAILROAD

POWER TRANSMISSION LINE (normally not shown)	
--	--

PIPE LINE (normally not shown)

FENCE (normally not shown)	
----------------------------	--

LEVEES

Without road	
With road	
With railroad	

DAMS

Large (to scale)	
Medium or small	

PITS

Gravel pit	
Mine or quarry	

MISCELLANEOUS CULTURAL FEATURES

Farmstead, house (omit in urban areas)	
Church	
School	
Indian mound (label)	
Located object (label)	
Tank (label)	
Wells, oil or gas	
Windmill	
Kitchen midden	

WATER FEATURES

DRAINAGE

Perennial, double line	
Perennial, single line	
Intermittent	
Drainage end	
Canals or ditches	
Double-line (label)	
Drainage and/or irrigation	

LAKES, PONDS AND RESERVOIRS

Perennial	
Intermittent	

MISCELLANEOUS WATER FEATURES

Marsh or swamp	
Spring	
Well, artesian	
Well, irrigation	
Wet spot	

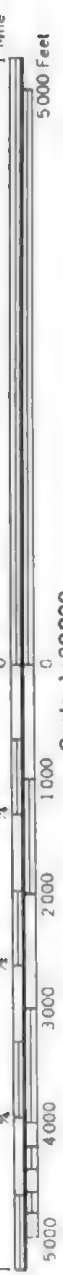
SPECIAL SYMBOLS FOR
SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS	
Bedrock (points down slope)	
Other than bedrock (points down slope)	
SHORT STEEP SLOPE	
GULLY	
DEPRESSION OR SINK	
SOIL SAMPLE SITE (normally not shown)	
MISCELLANEOUS	
Blowout	
Clay spot	
Gravelly spot	
Gumbo, slick or scabby spot (sodic)	
Dumps and other similar non soil areas	
Prominent hill or peak	
Rock outcrop (includes sandstone and shale)	
Saline spot	
Sandy spot	
Severely eroded spot	
Slide or slip (tips point upslope)	
Stony spot, very stony spot	
Shale spot	
Glacial till spot up to two acres in size	

BENSON COUNTY AREA, NORTH DAKOTA — SHEET NUMBER 1

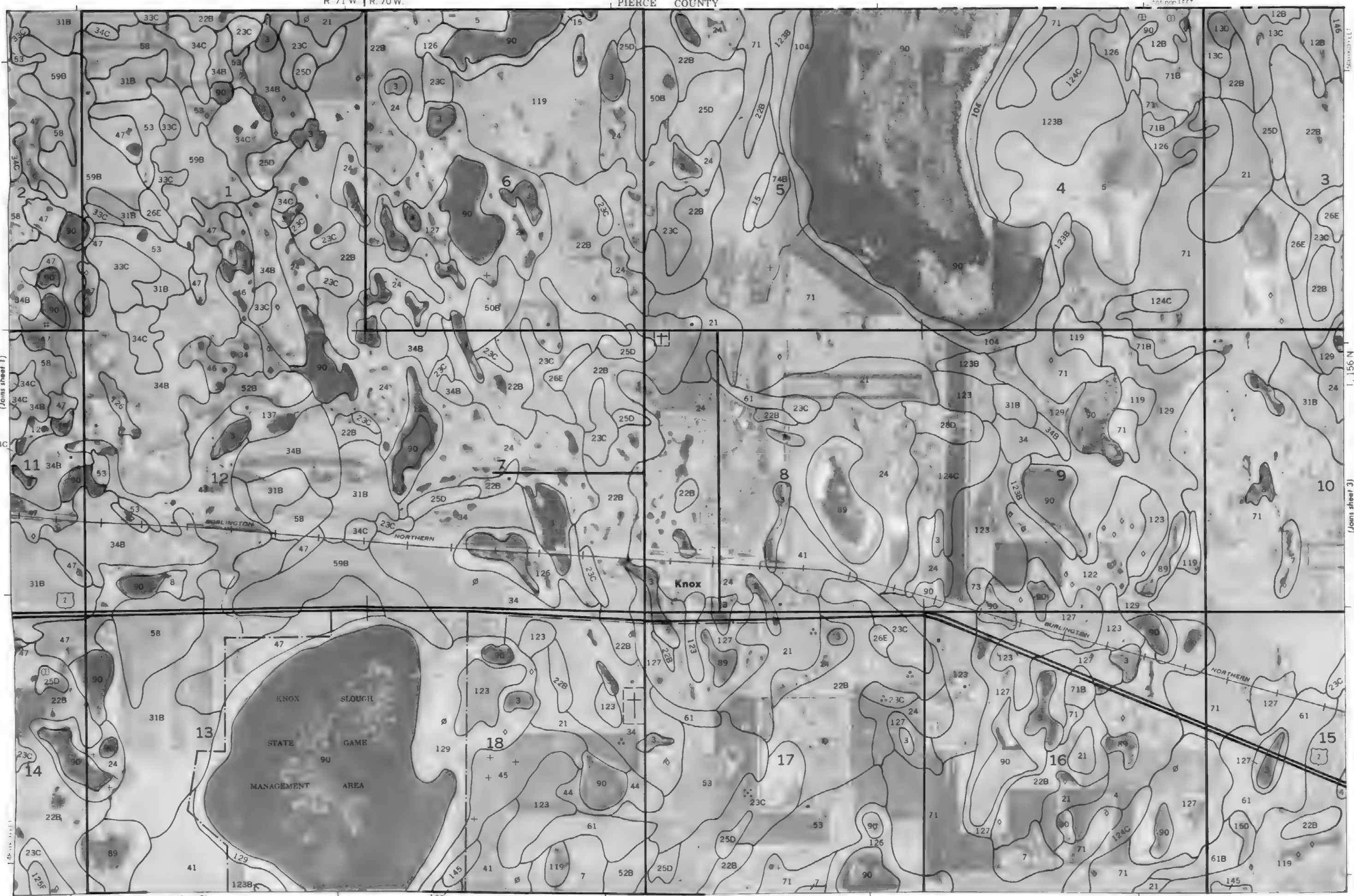




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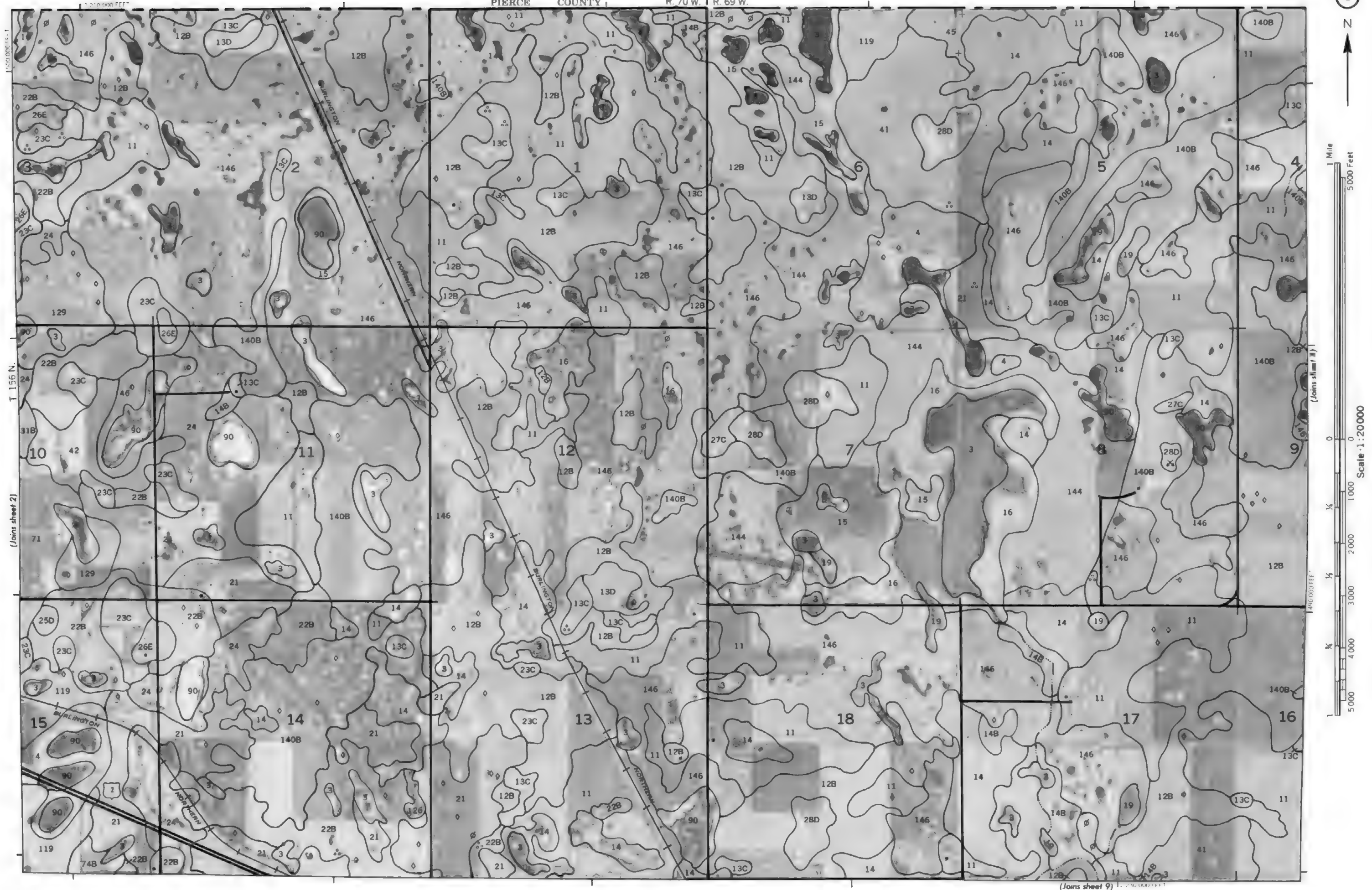
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(Joins sheet 3)



3

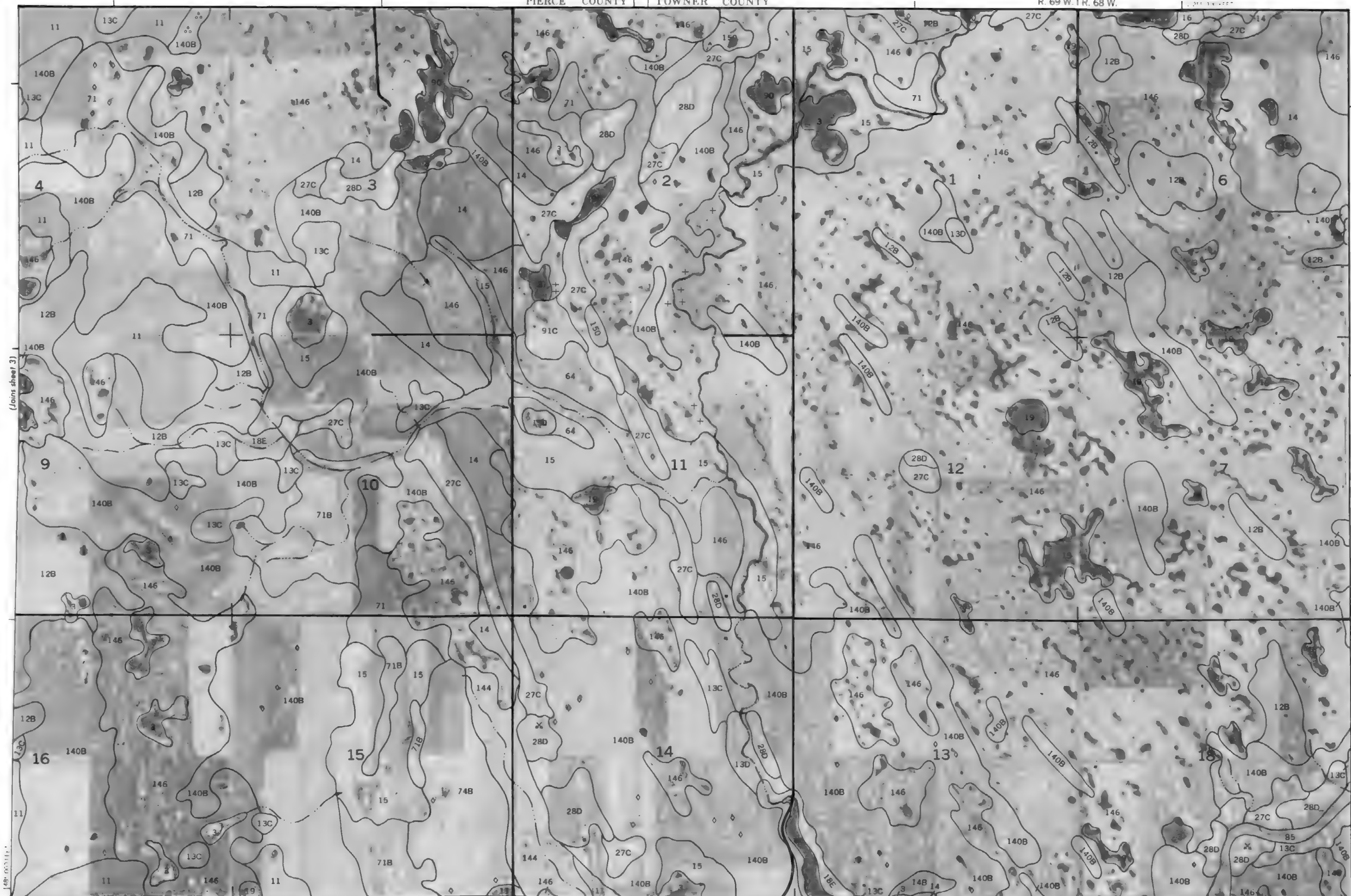
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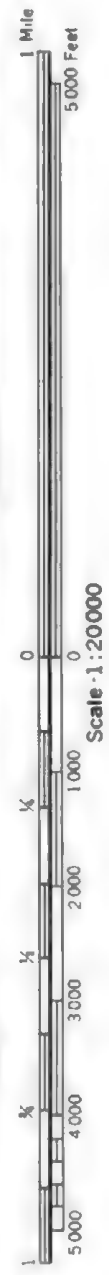
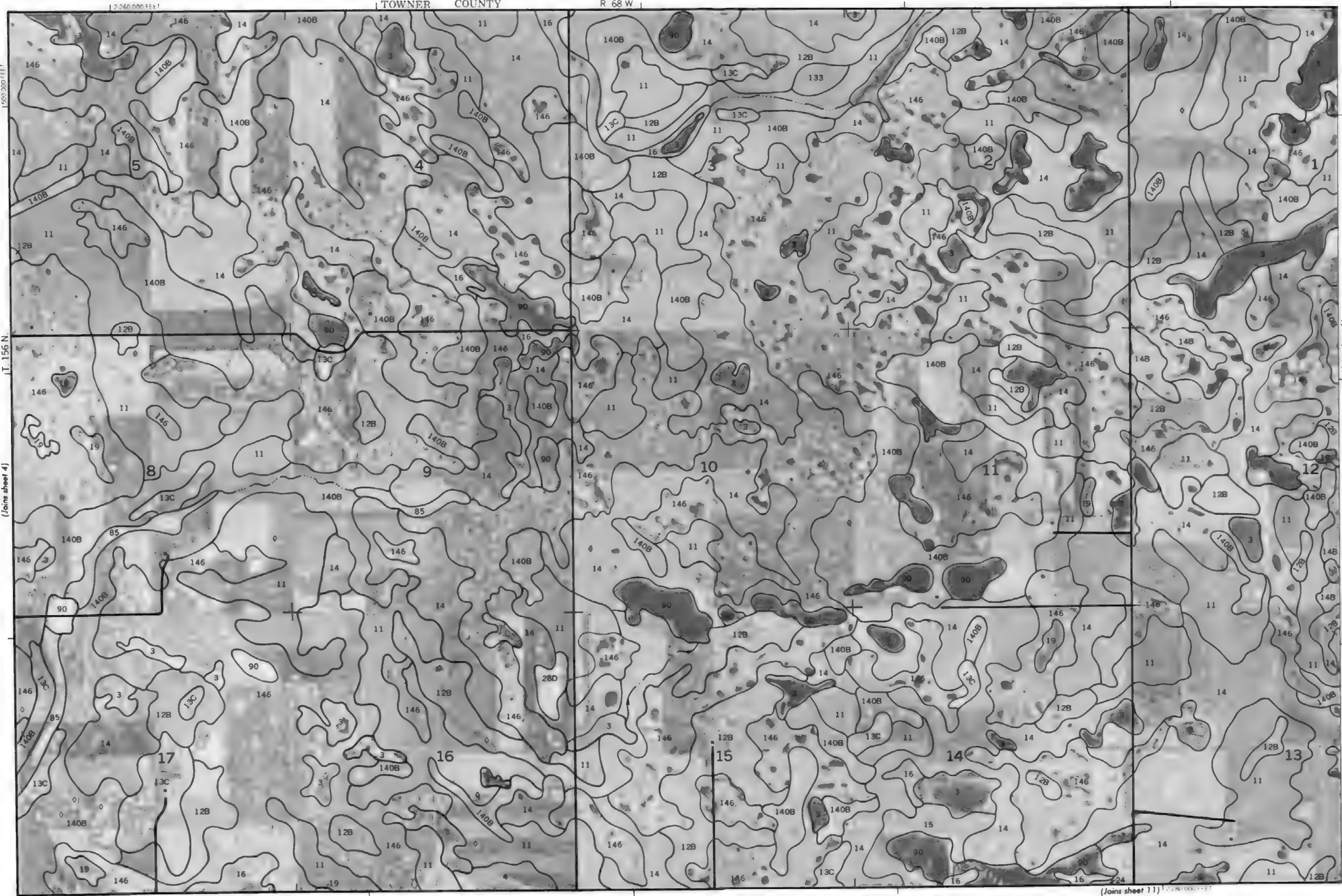
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5000 Feet

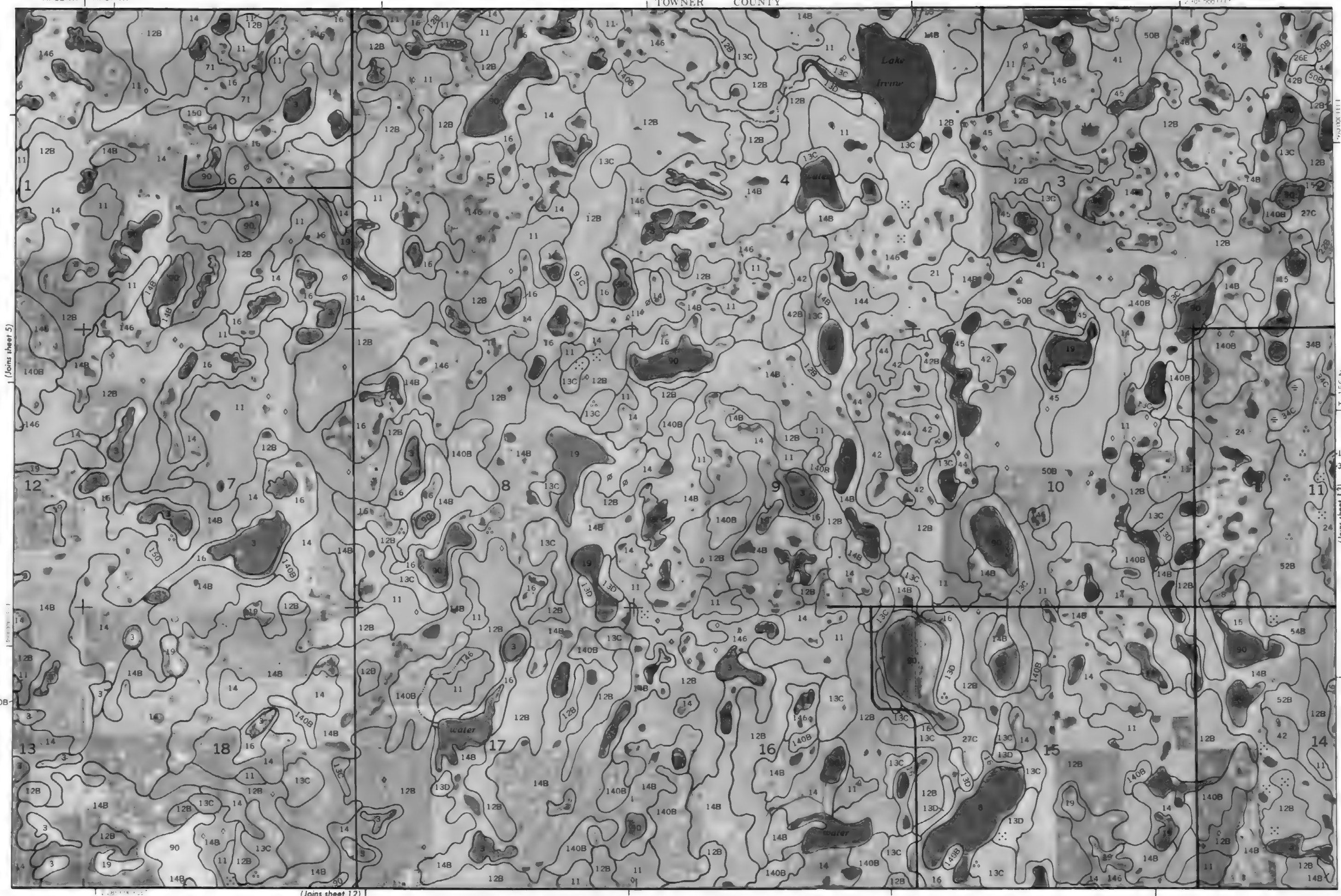
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BENSON COUNTY AREA, NORTH DAKOTA — SHEET NUMBER 5

TOWNER COUNTY R 68 W





2 160 000 FEET

R 71 W.

(Joins sheet 1)

7



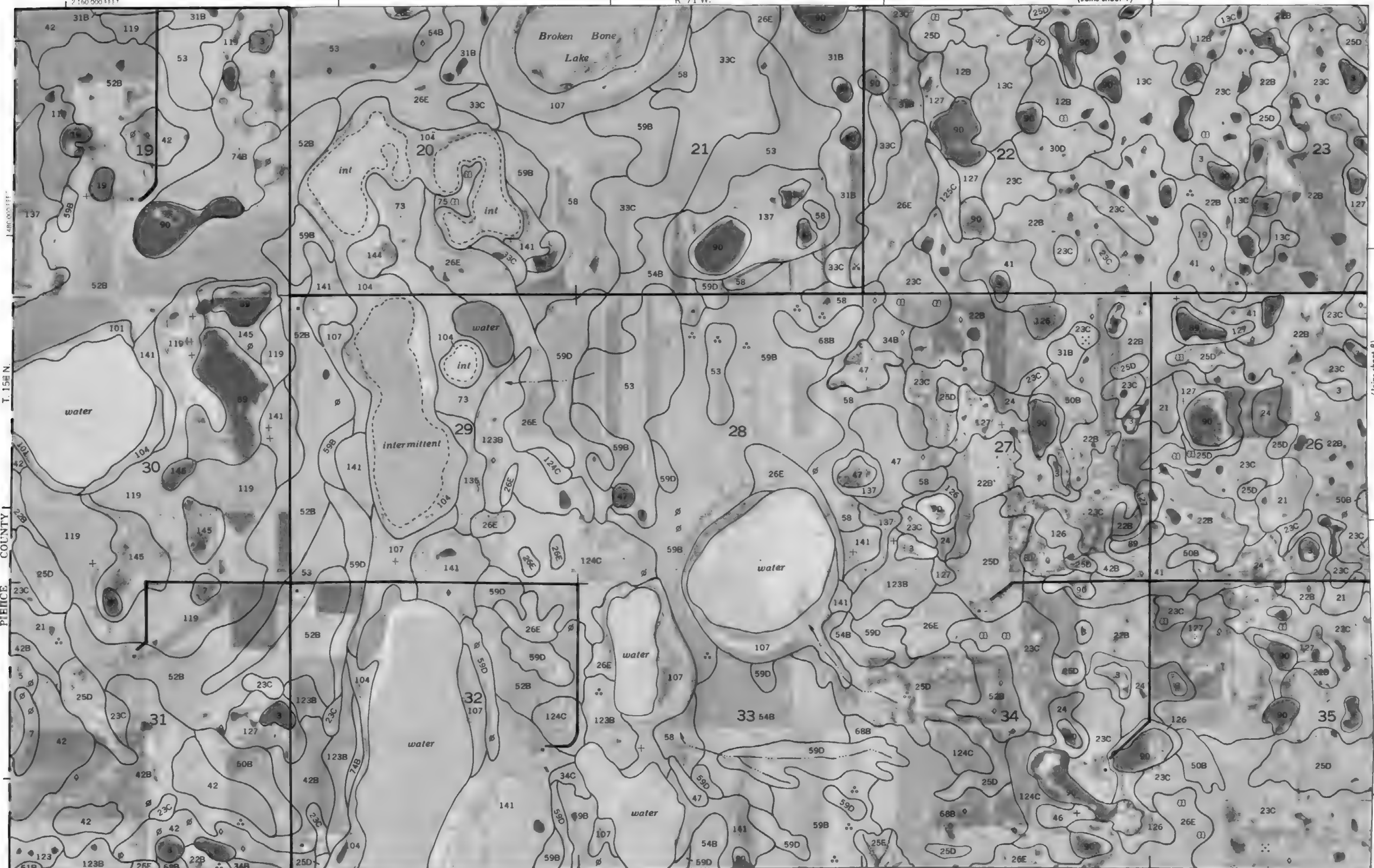
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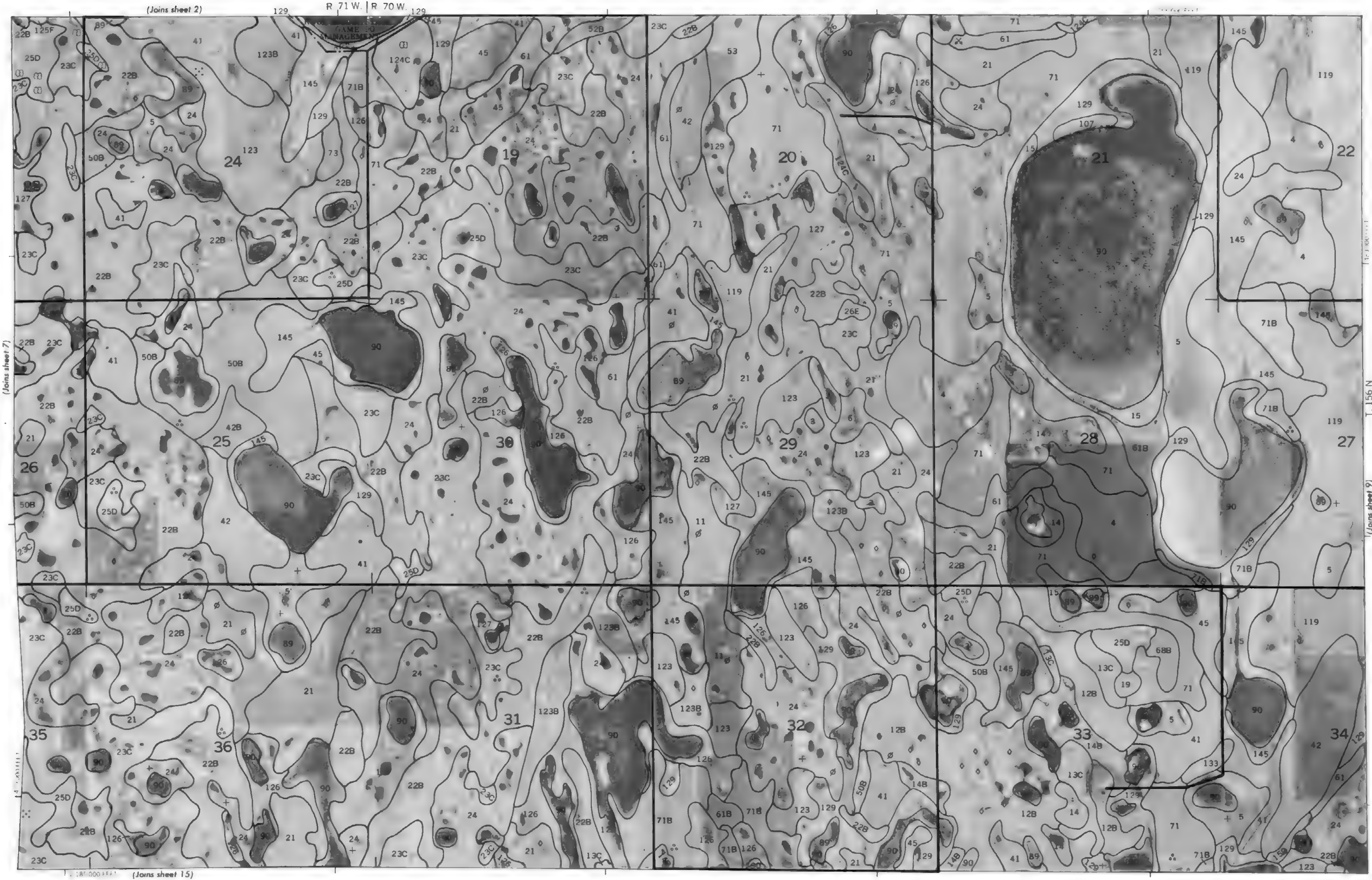
(Joins sheet 14) 2 160 000 FEET

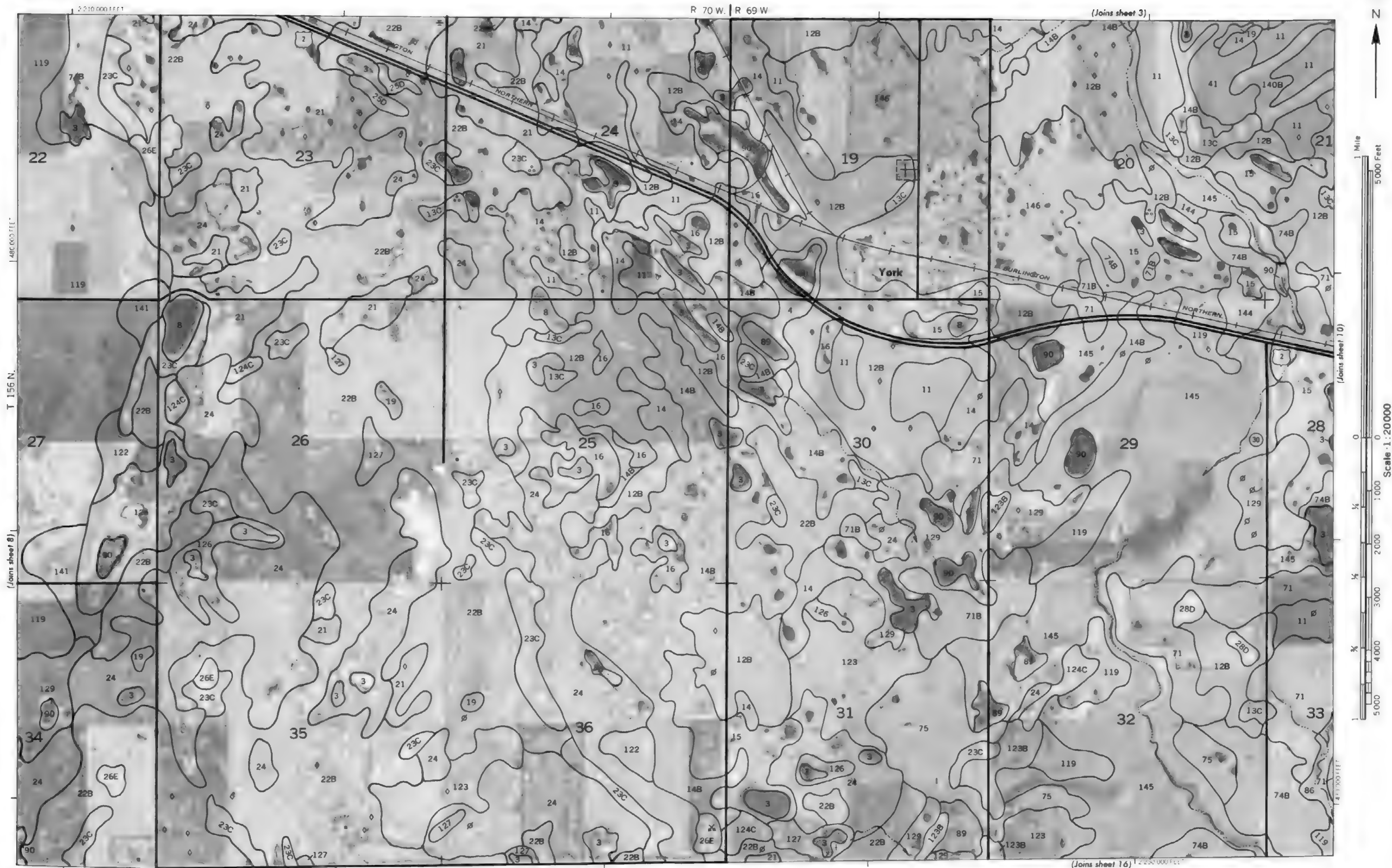
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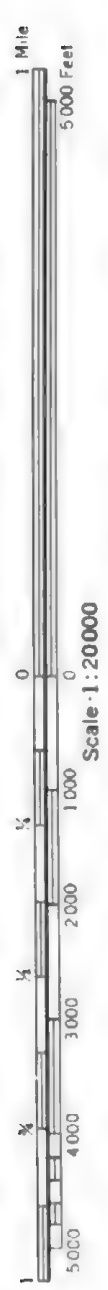
PURCELL COUNTY

1480 000 FEET

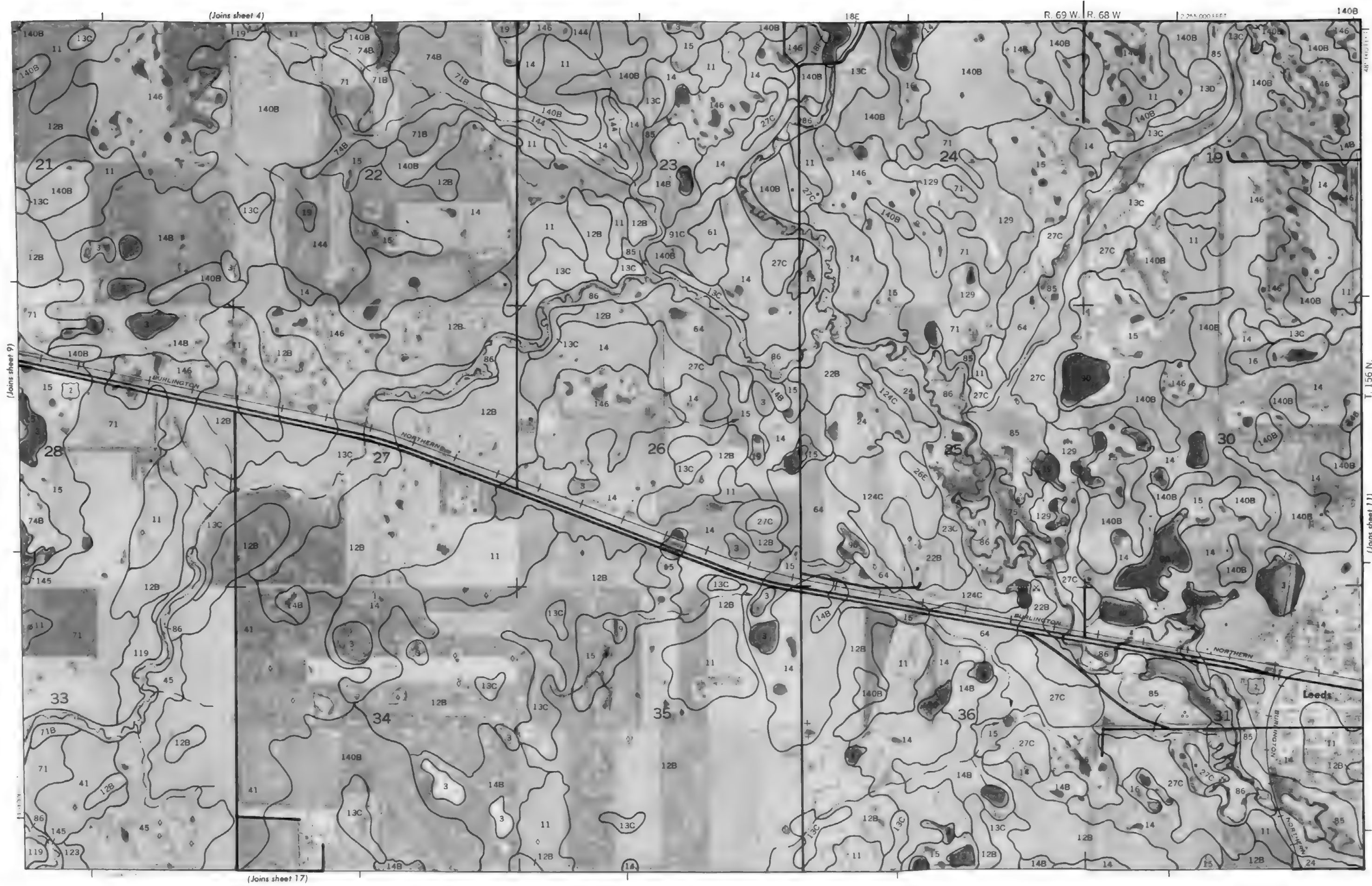


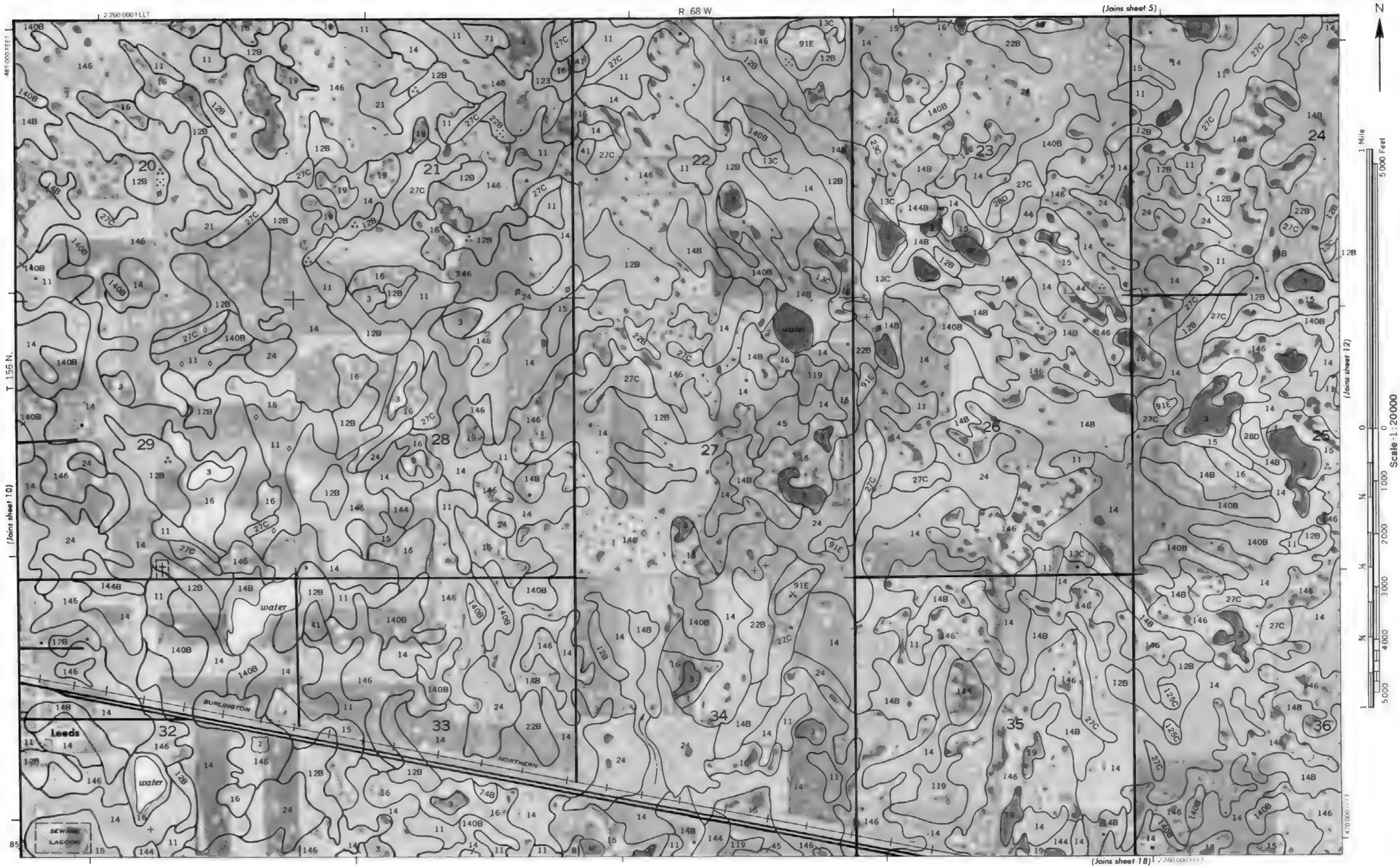






Scale 1:20000





R 68 W | R 67 W

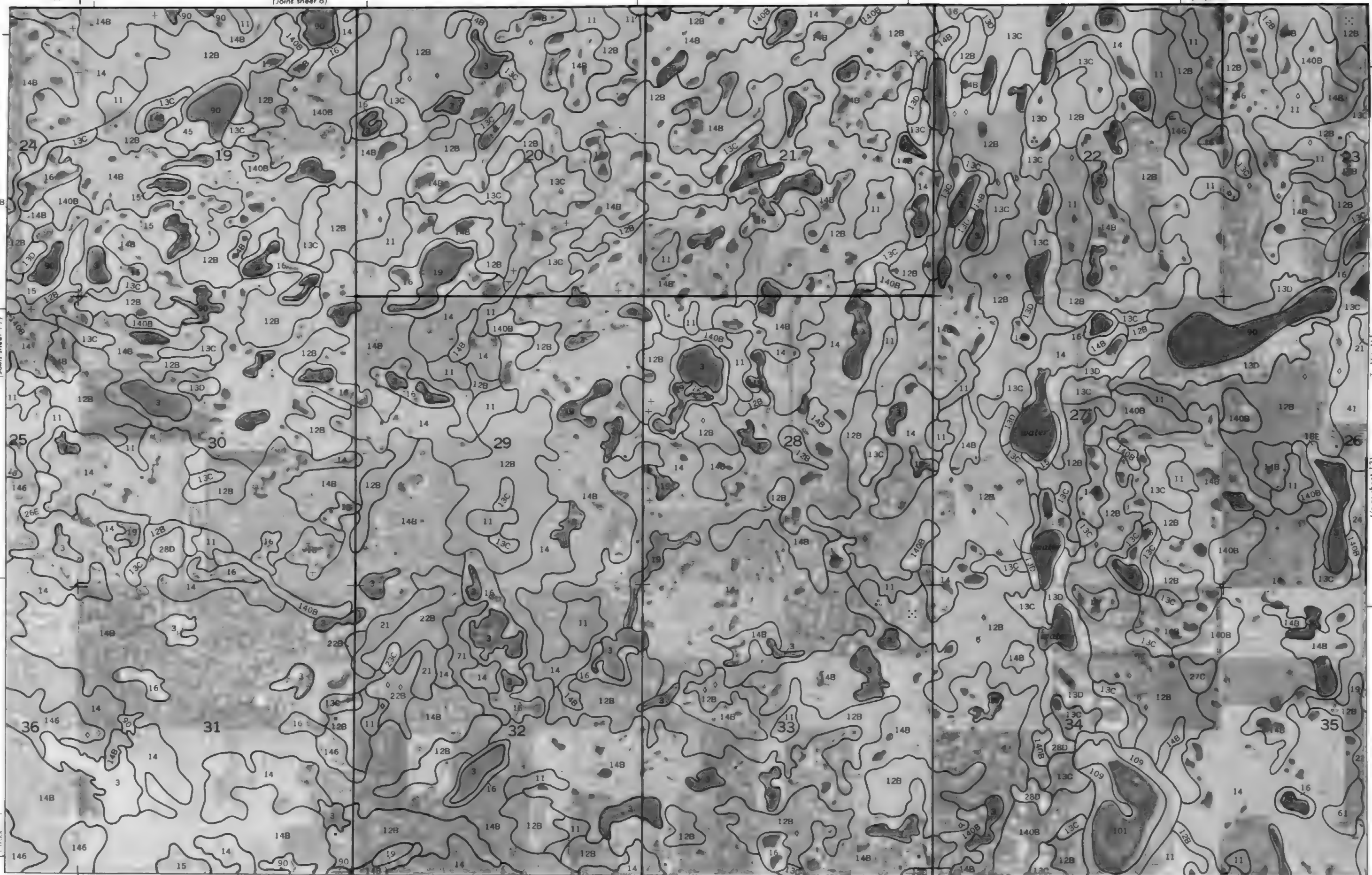
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1 Mile
5000 Feet

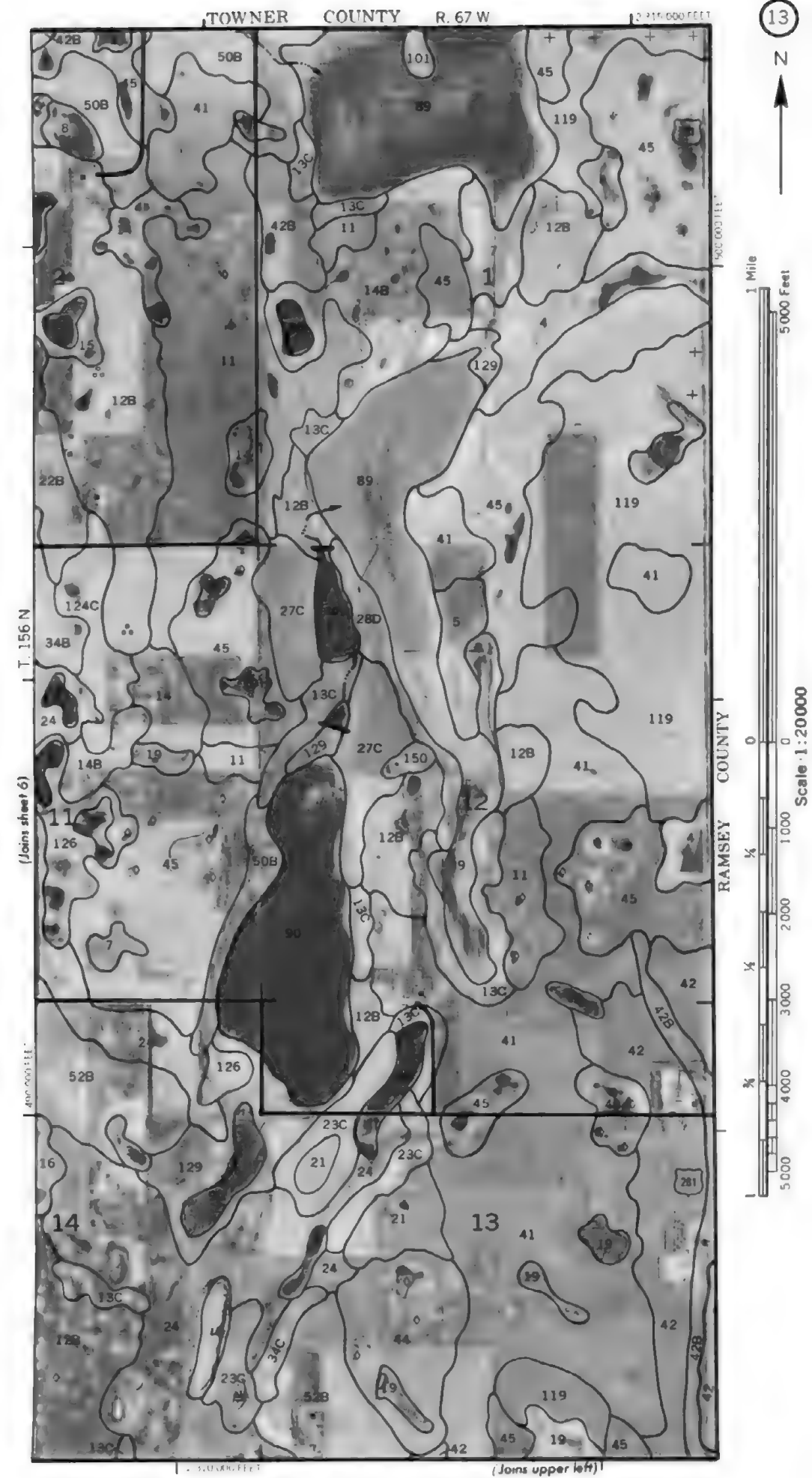
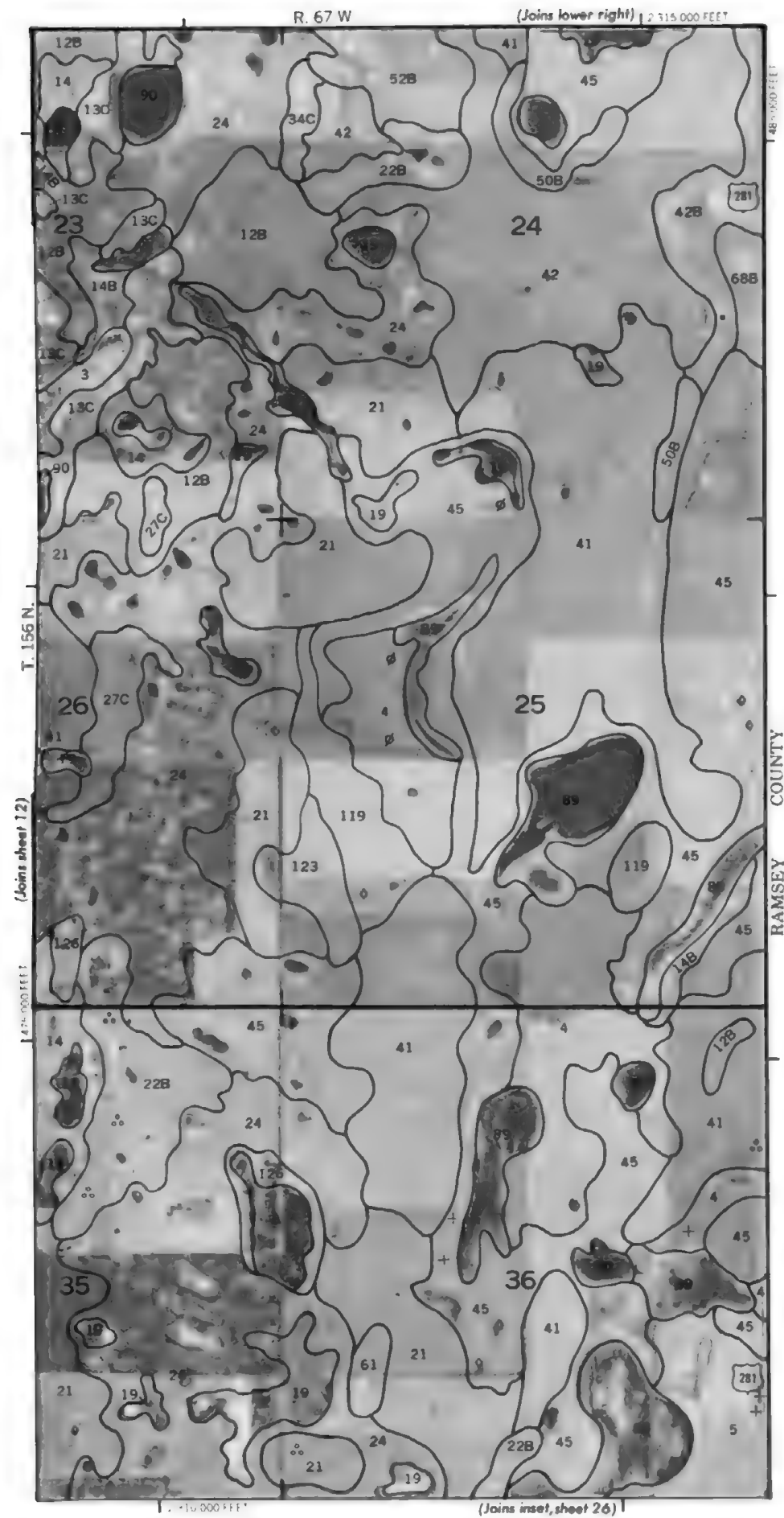
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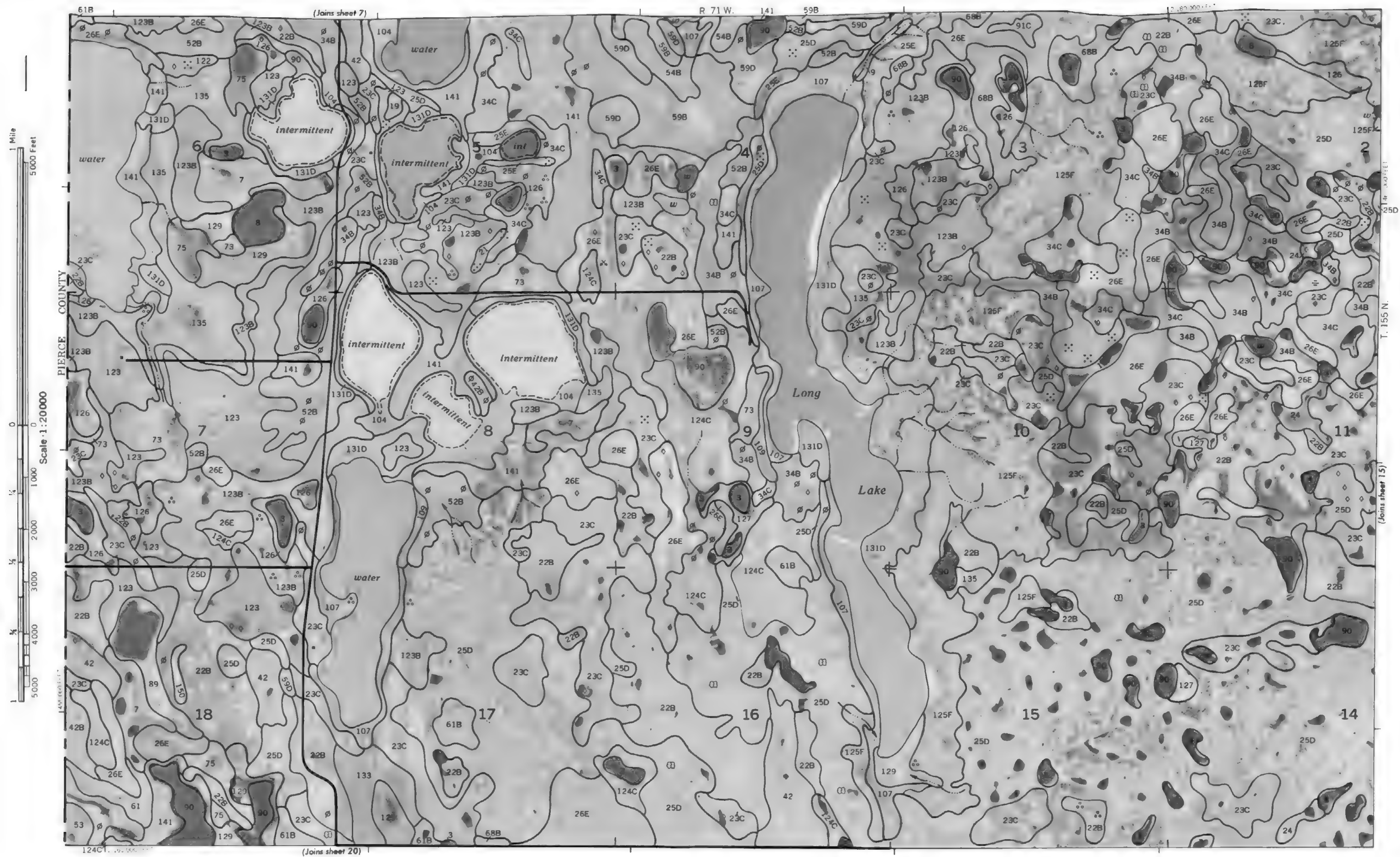
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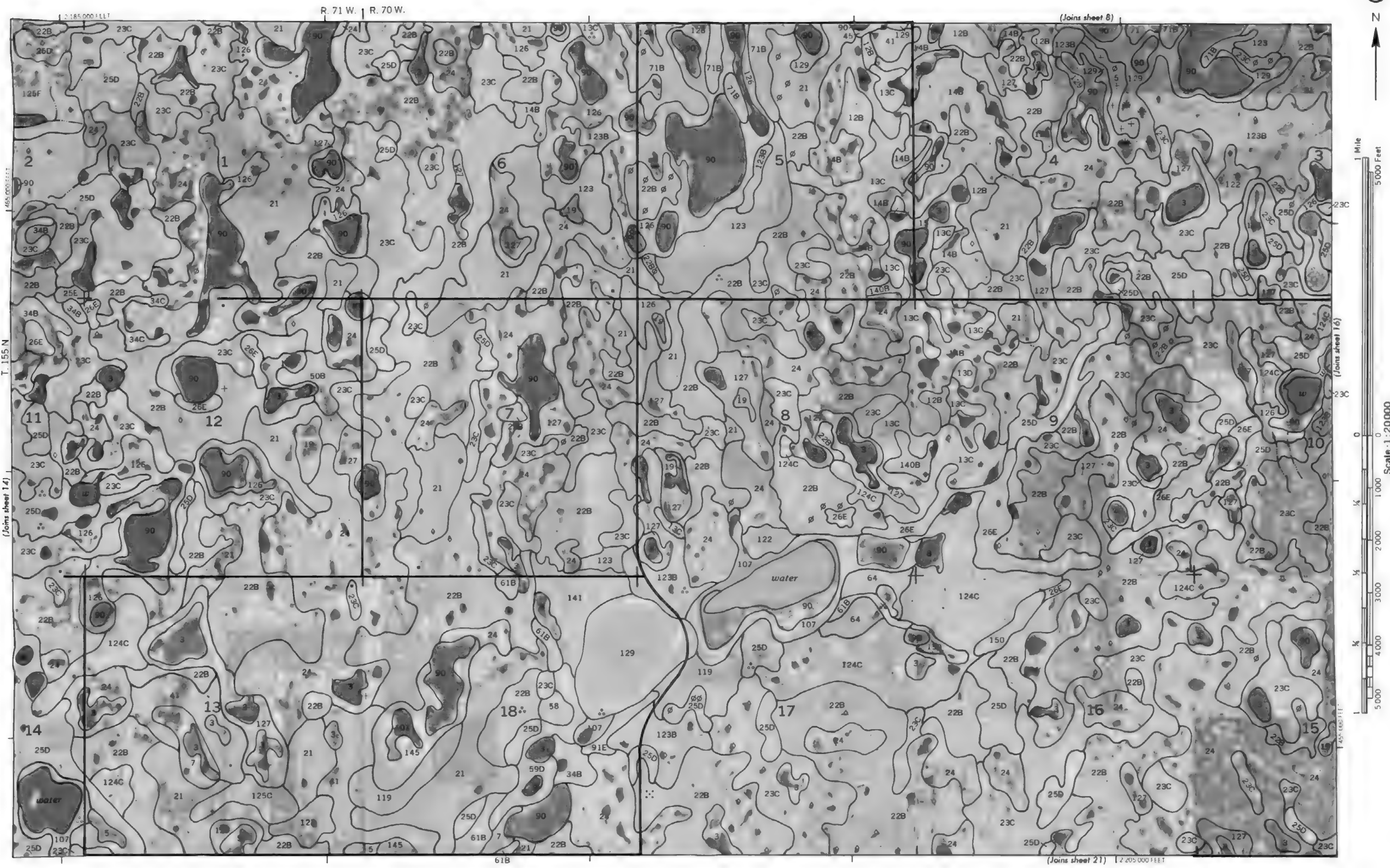


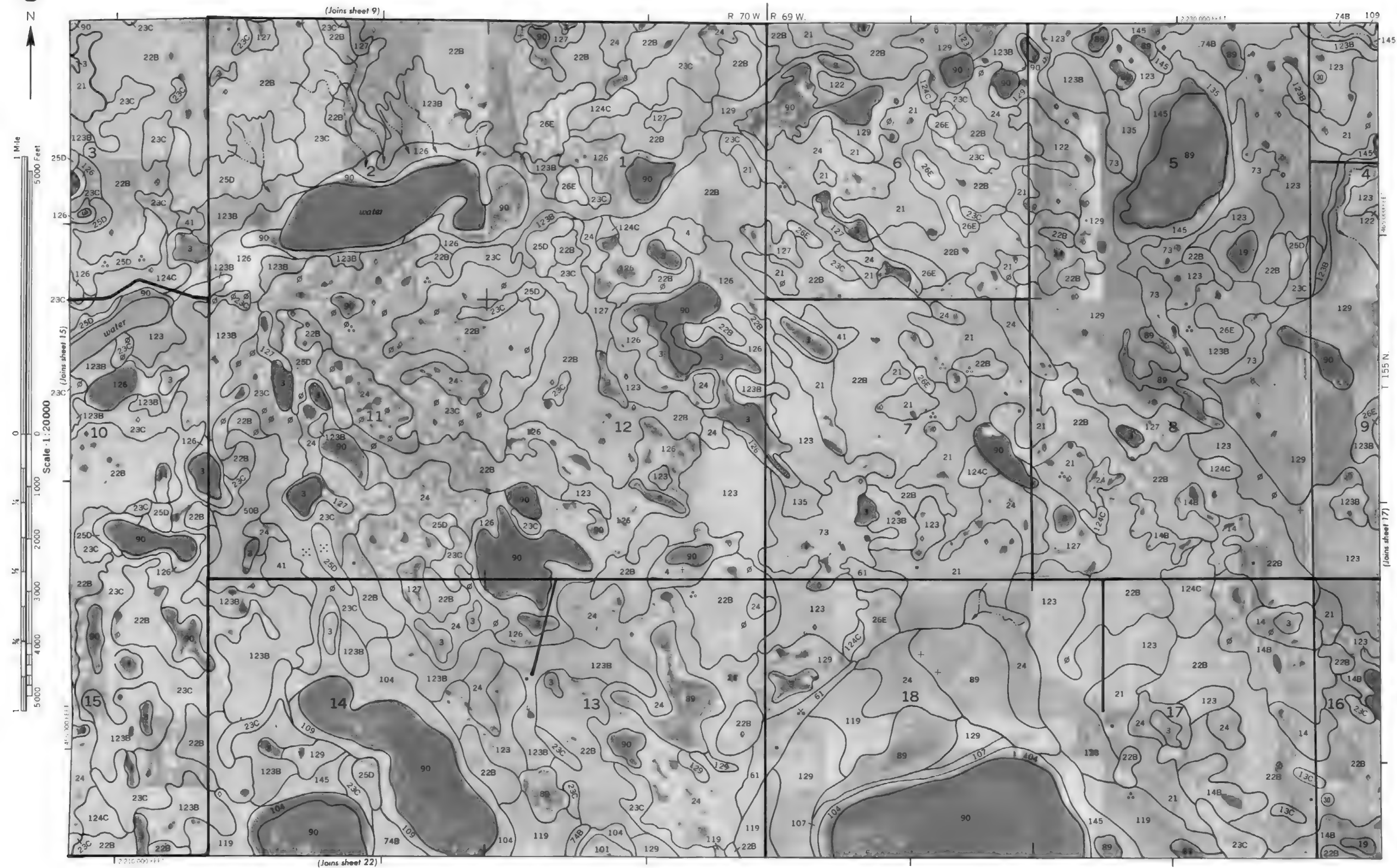
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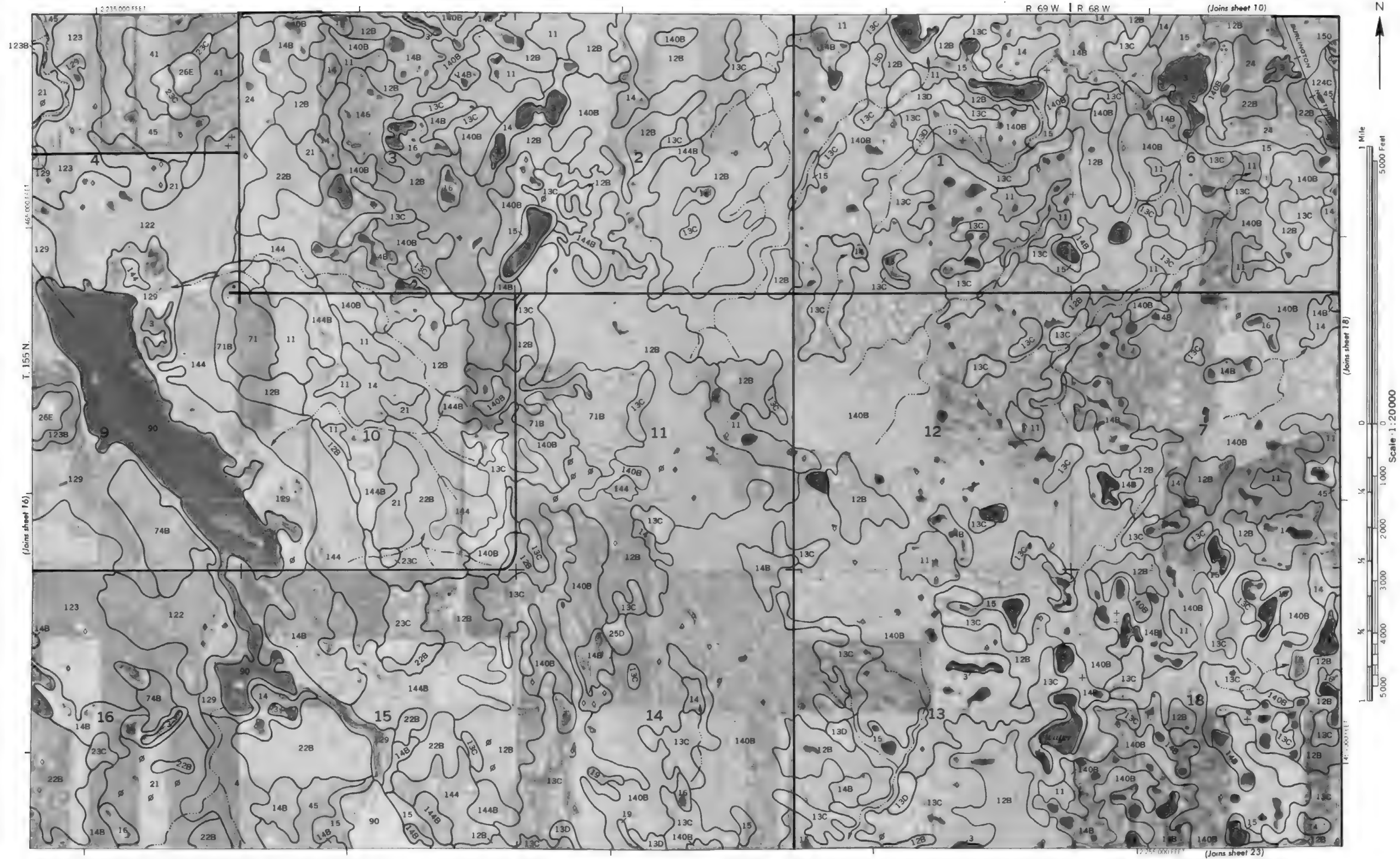
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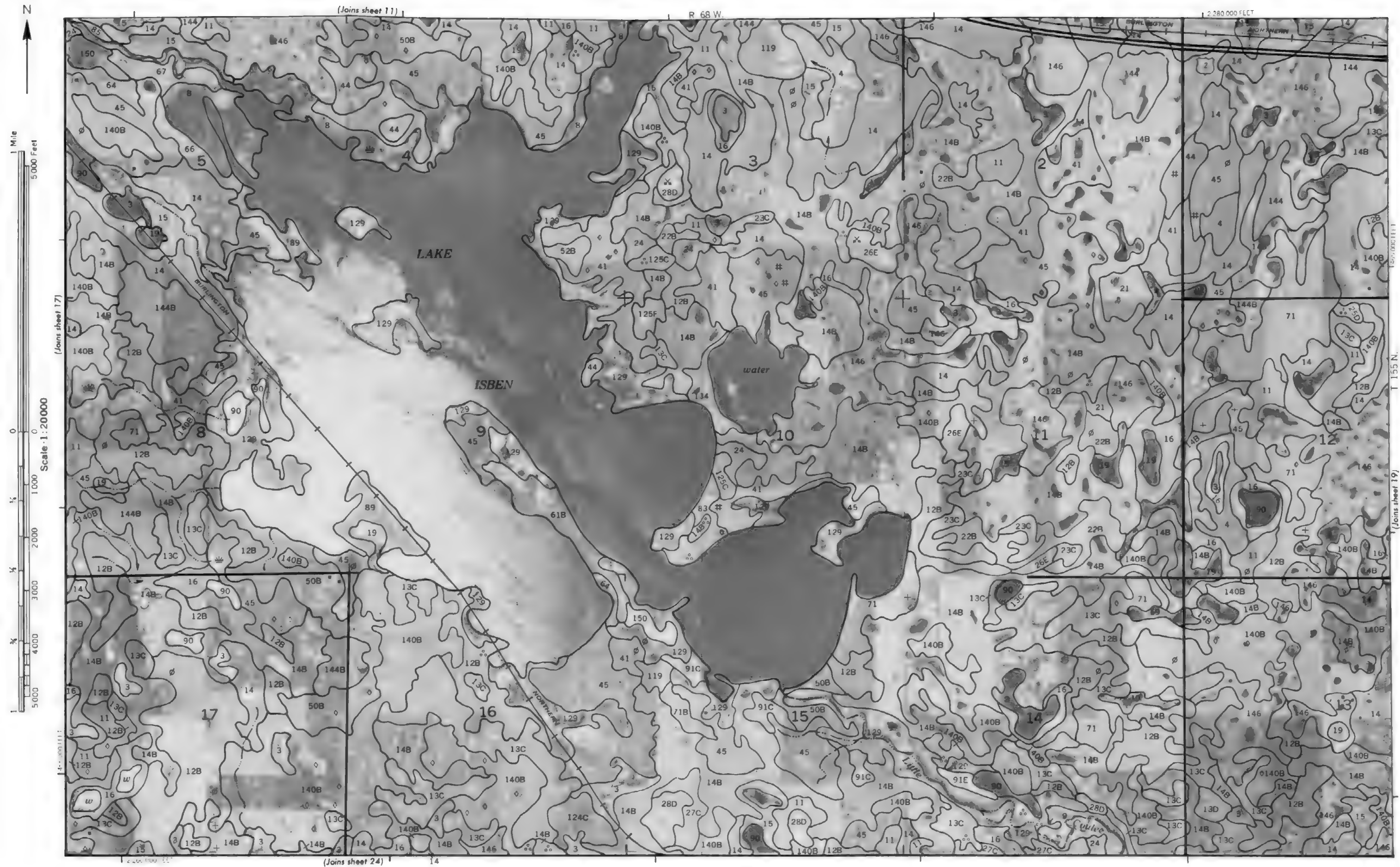




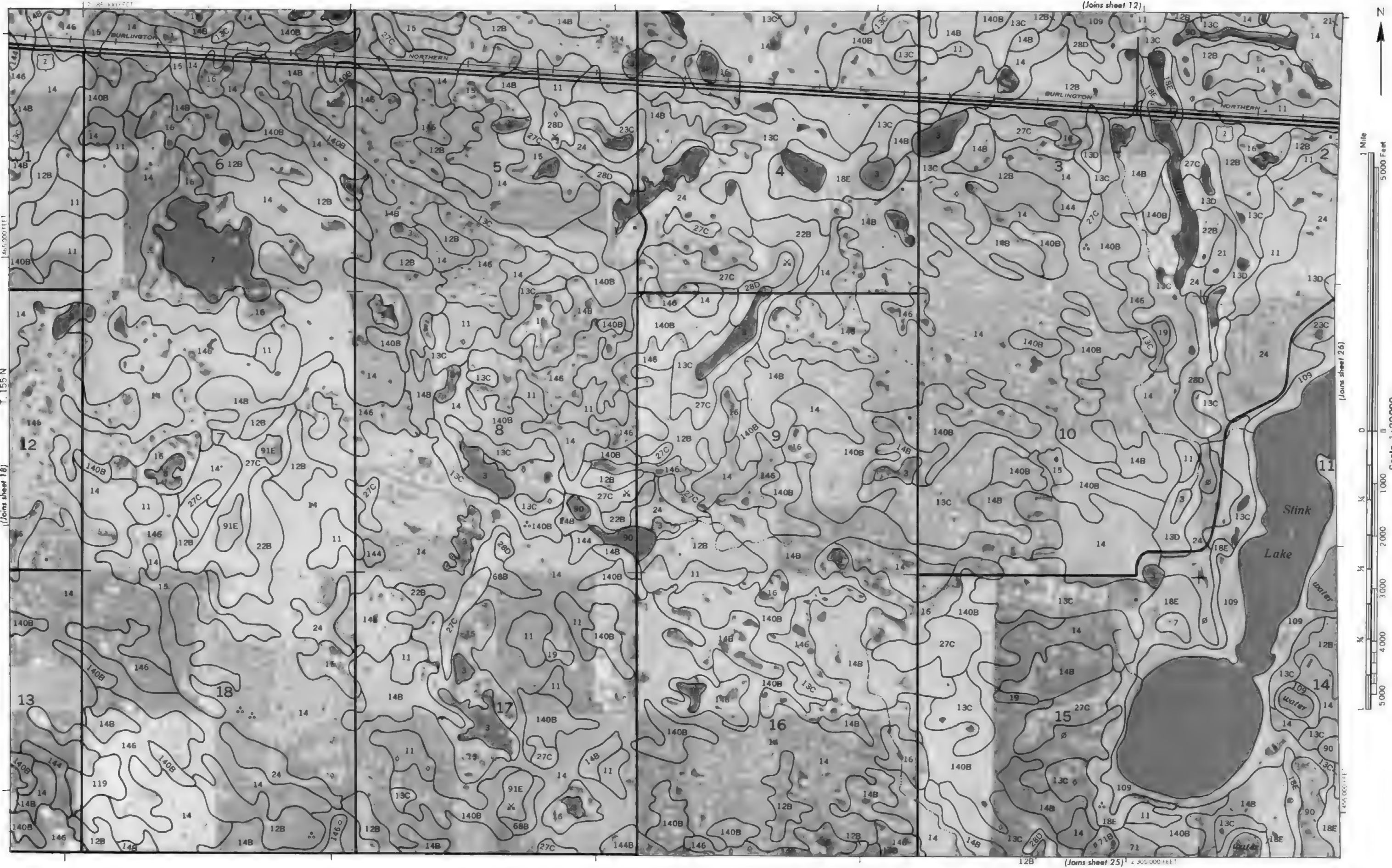


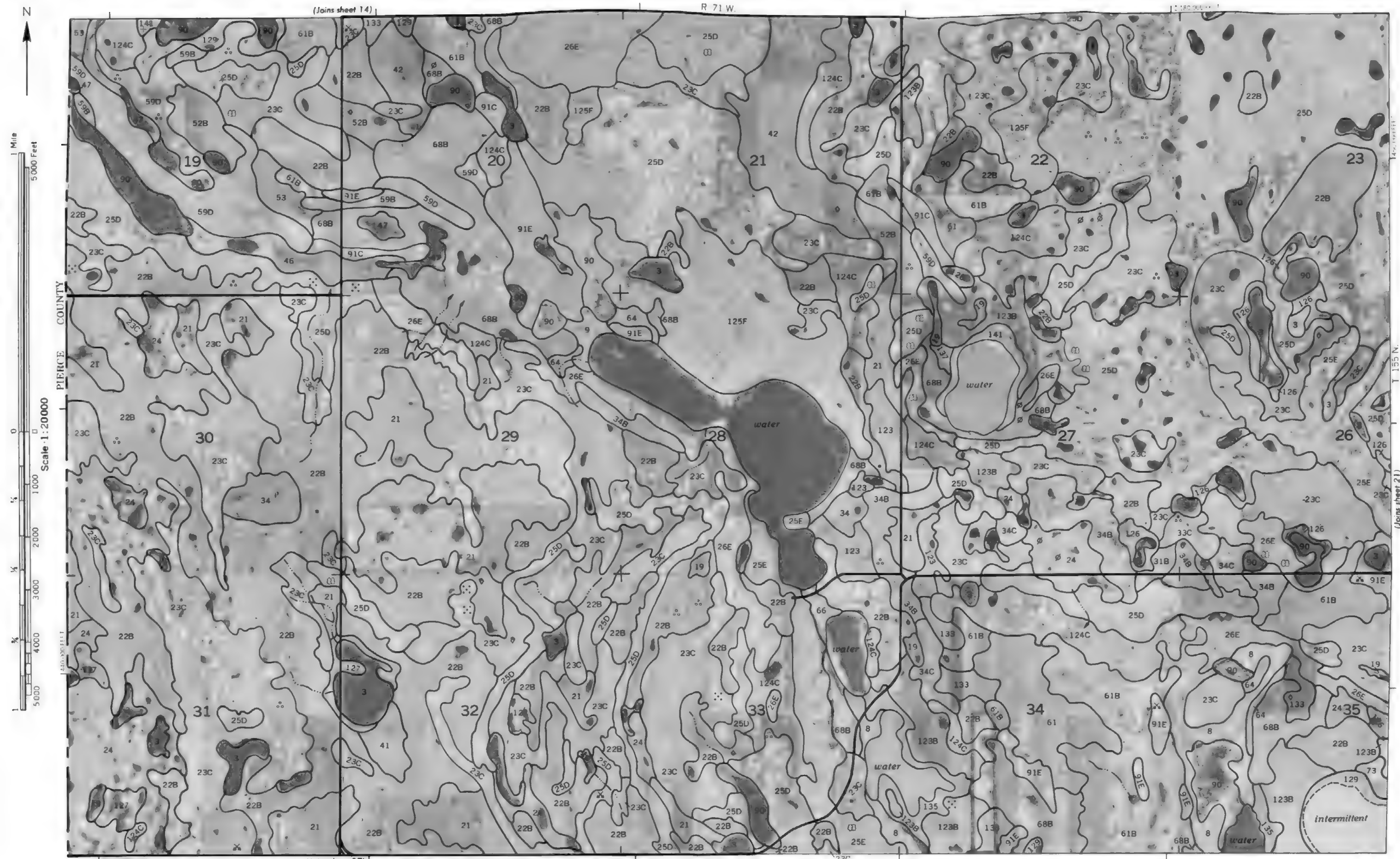


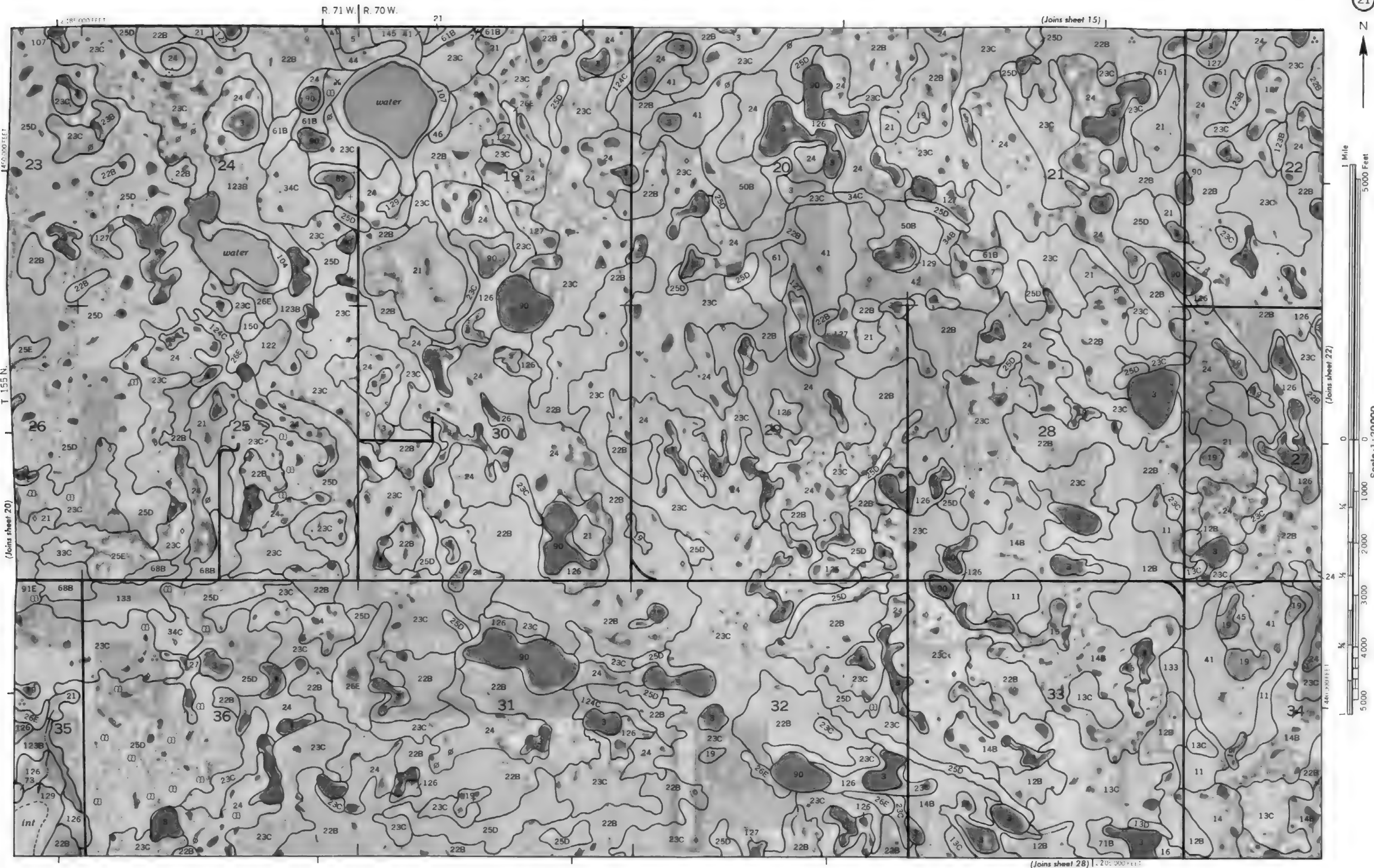


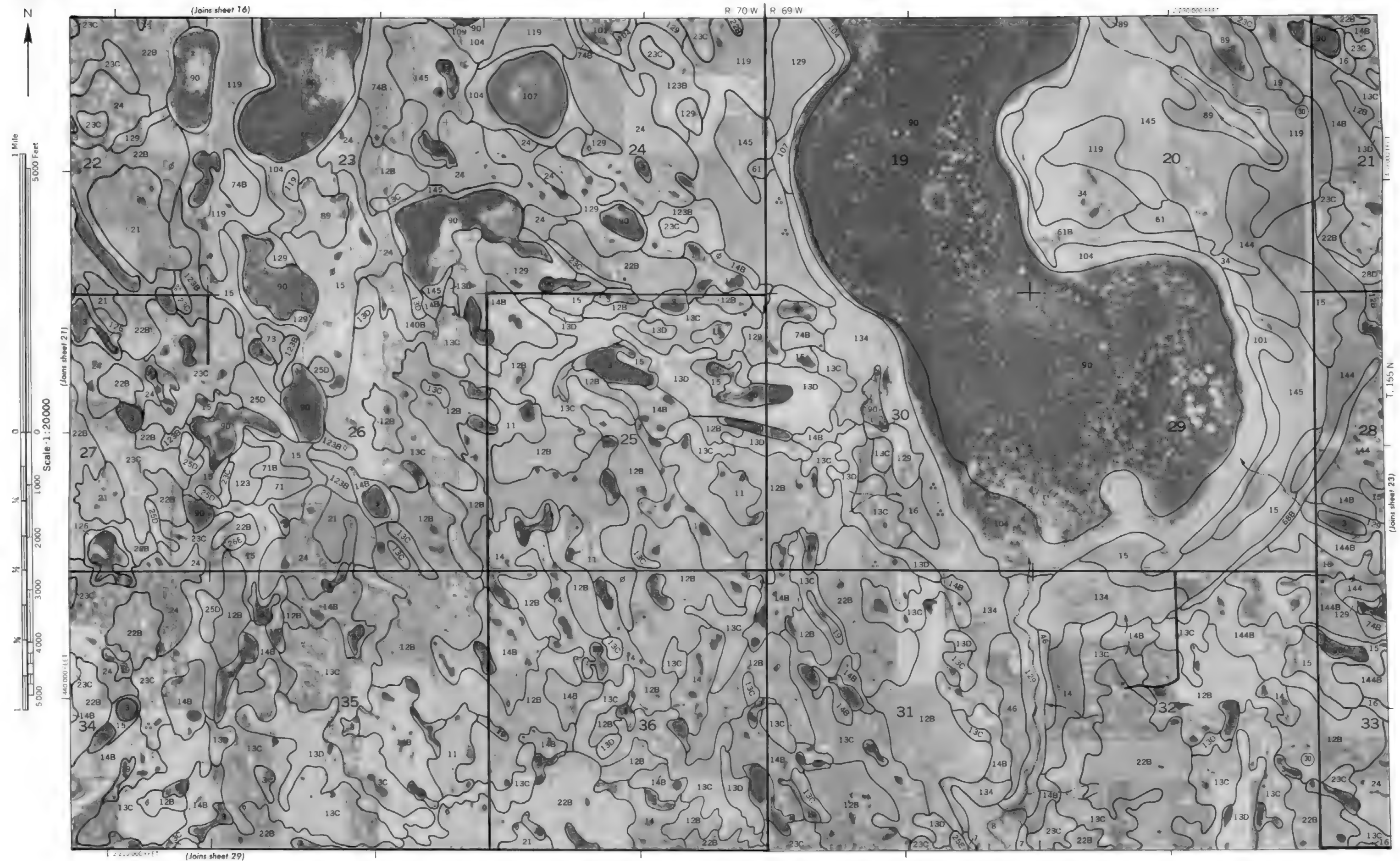


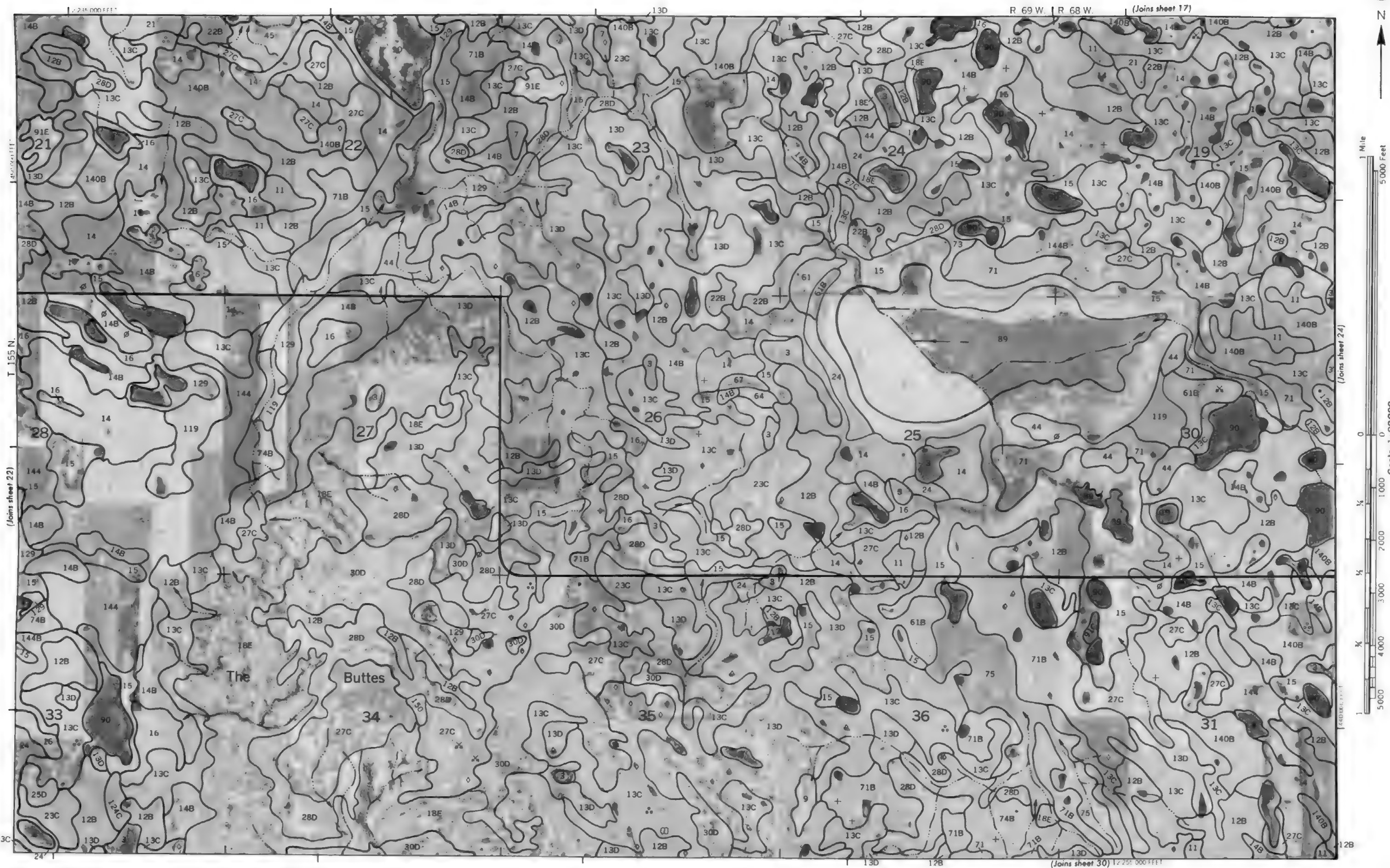
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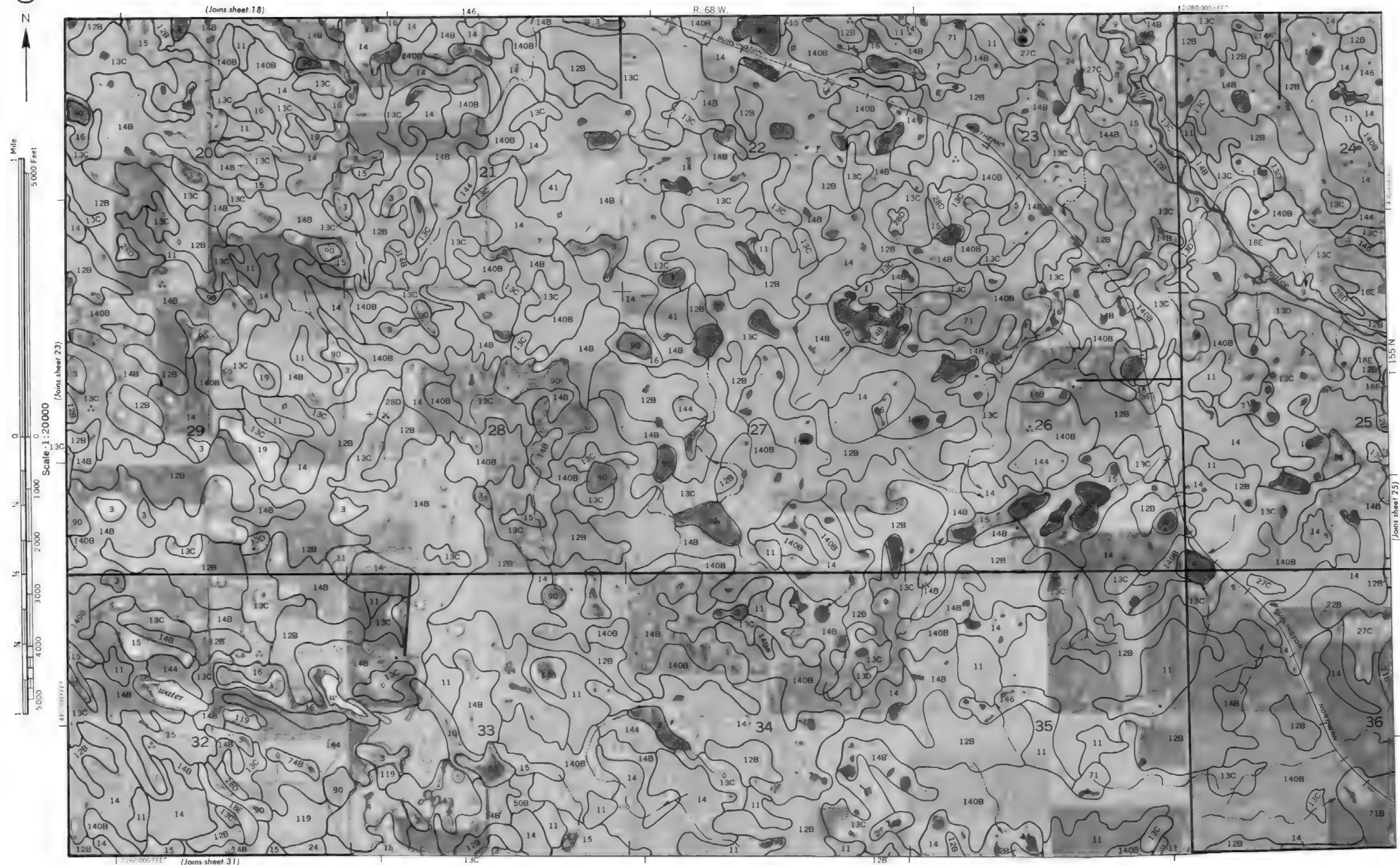


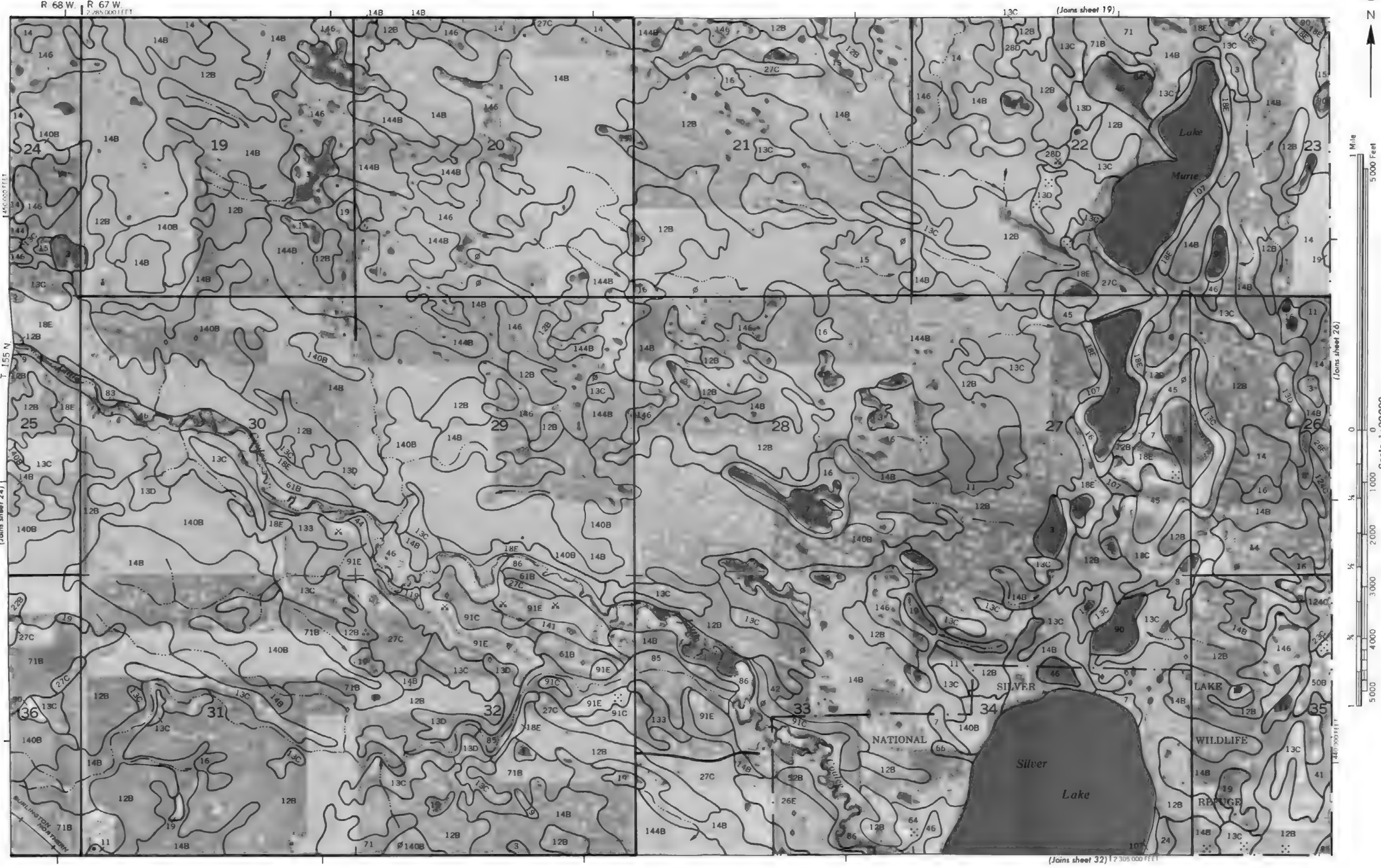


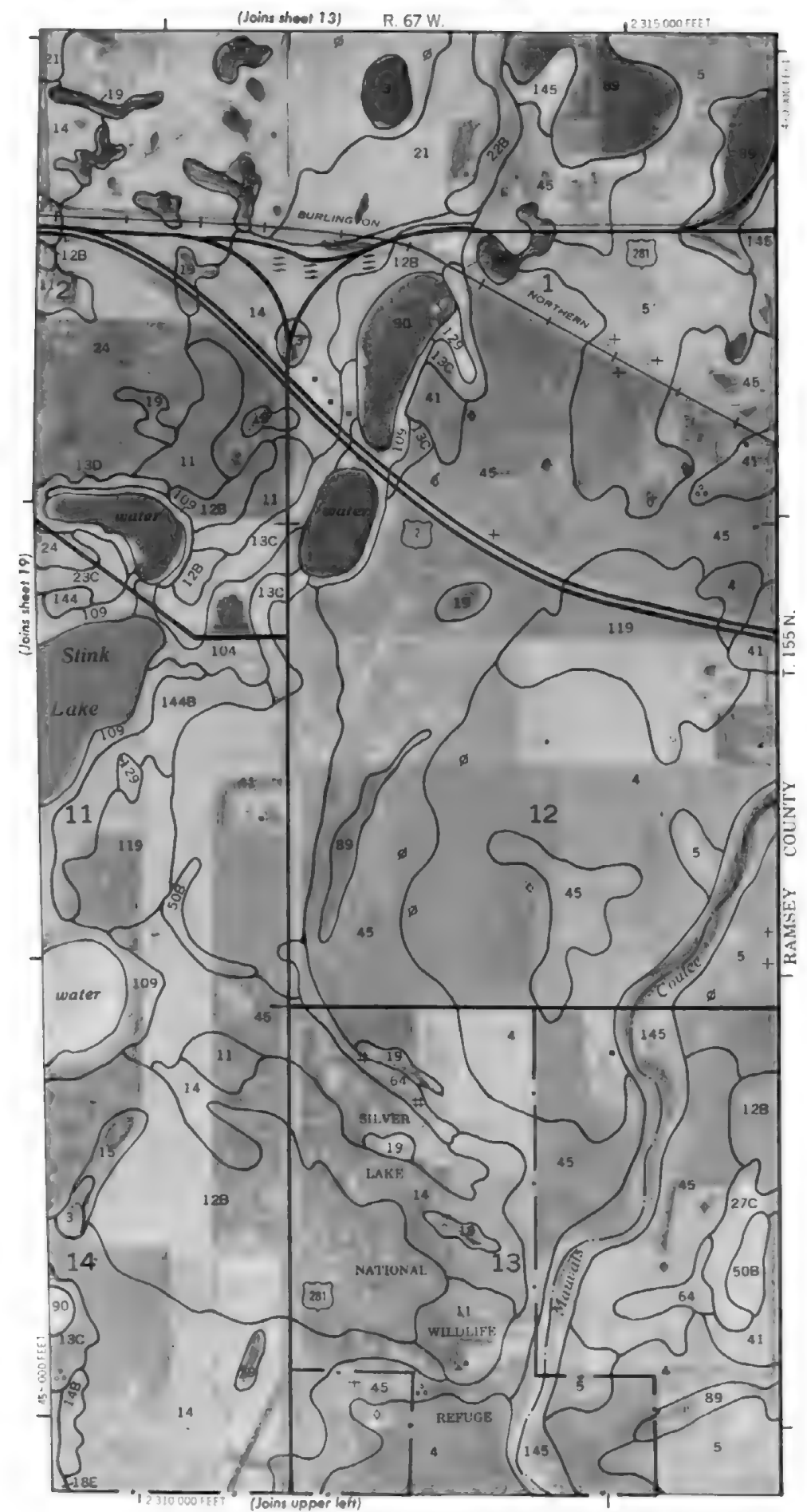


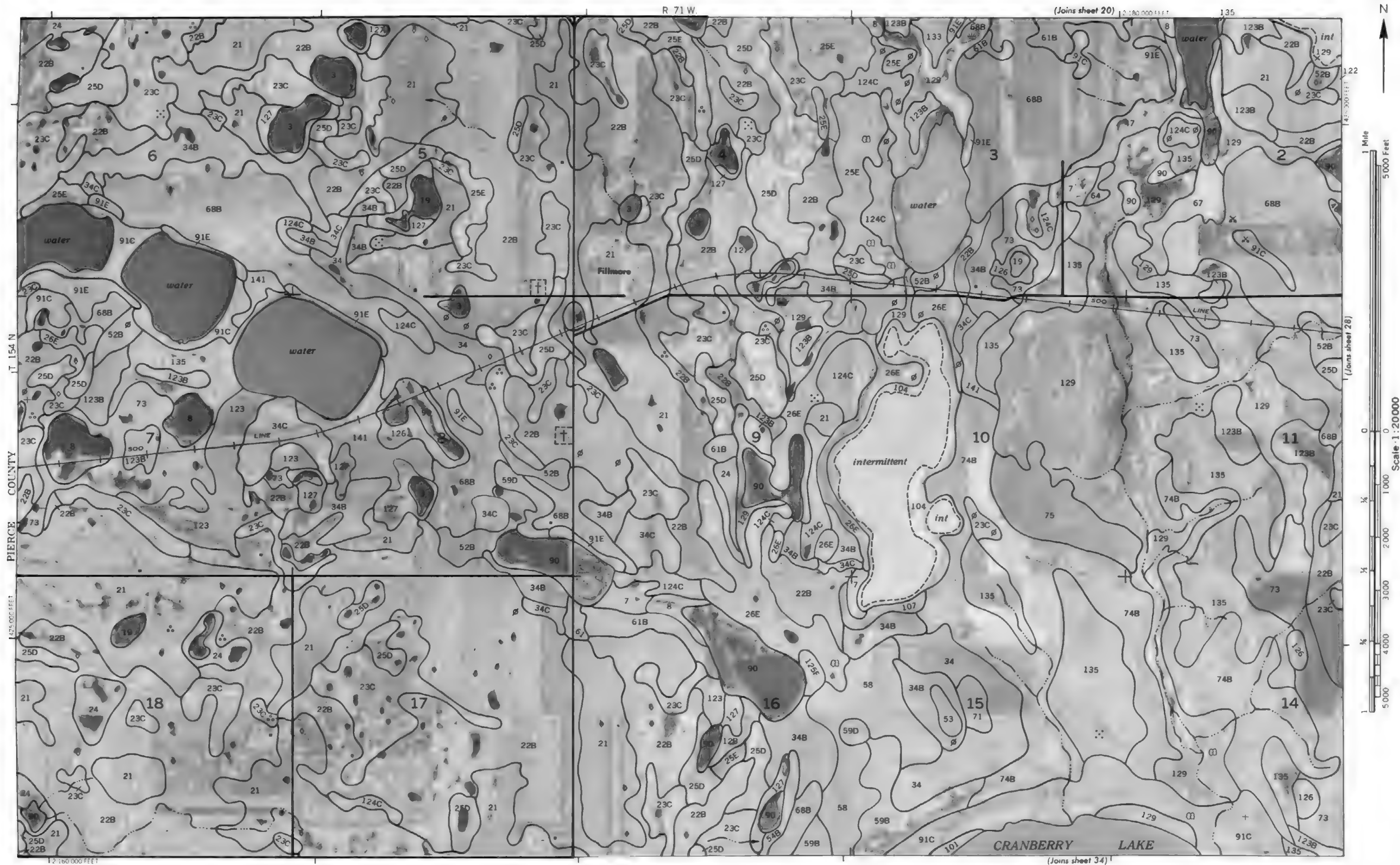


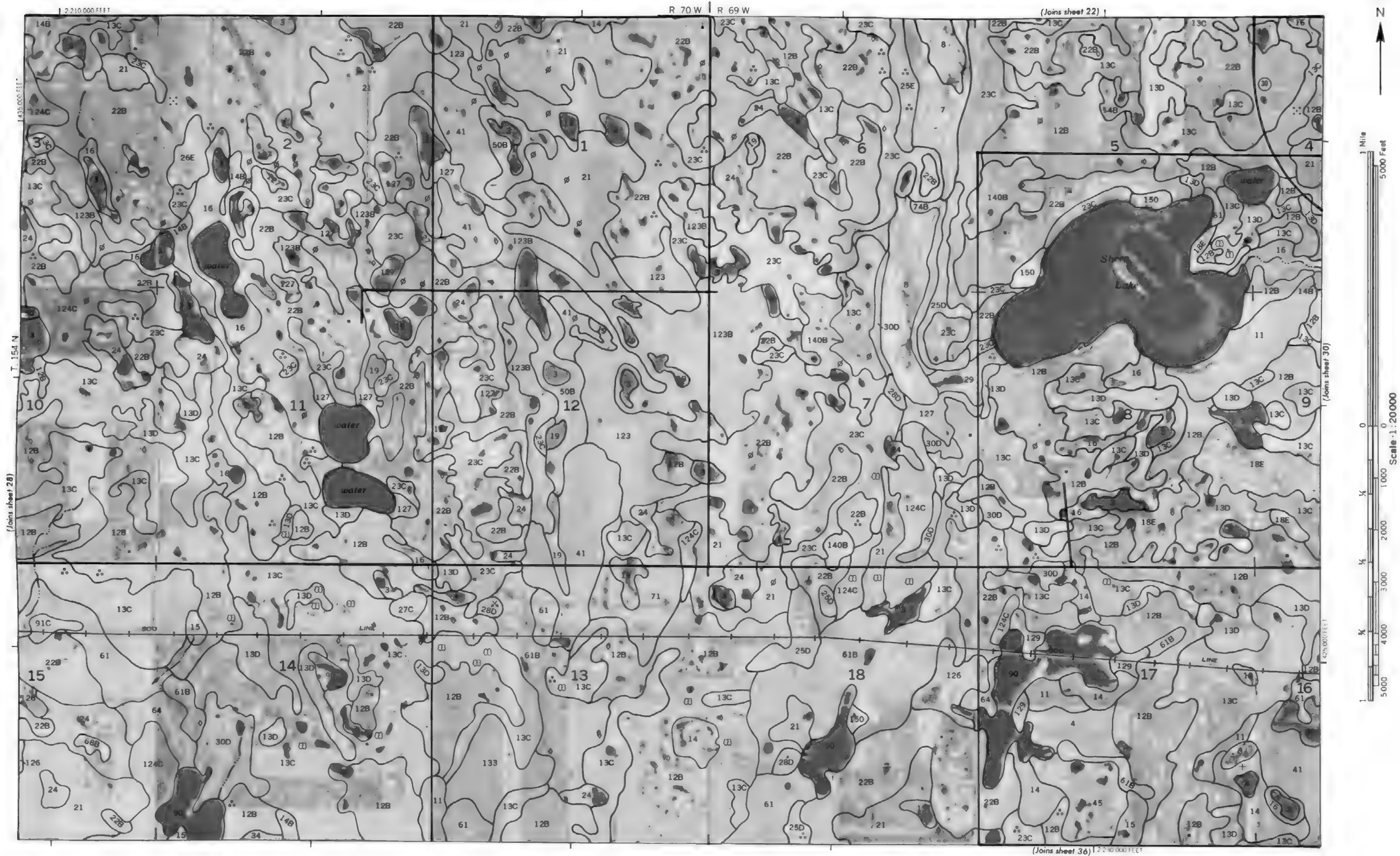










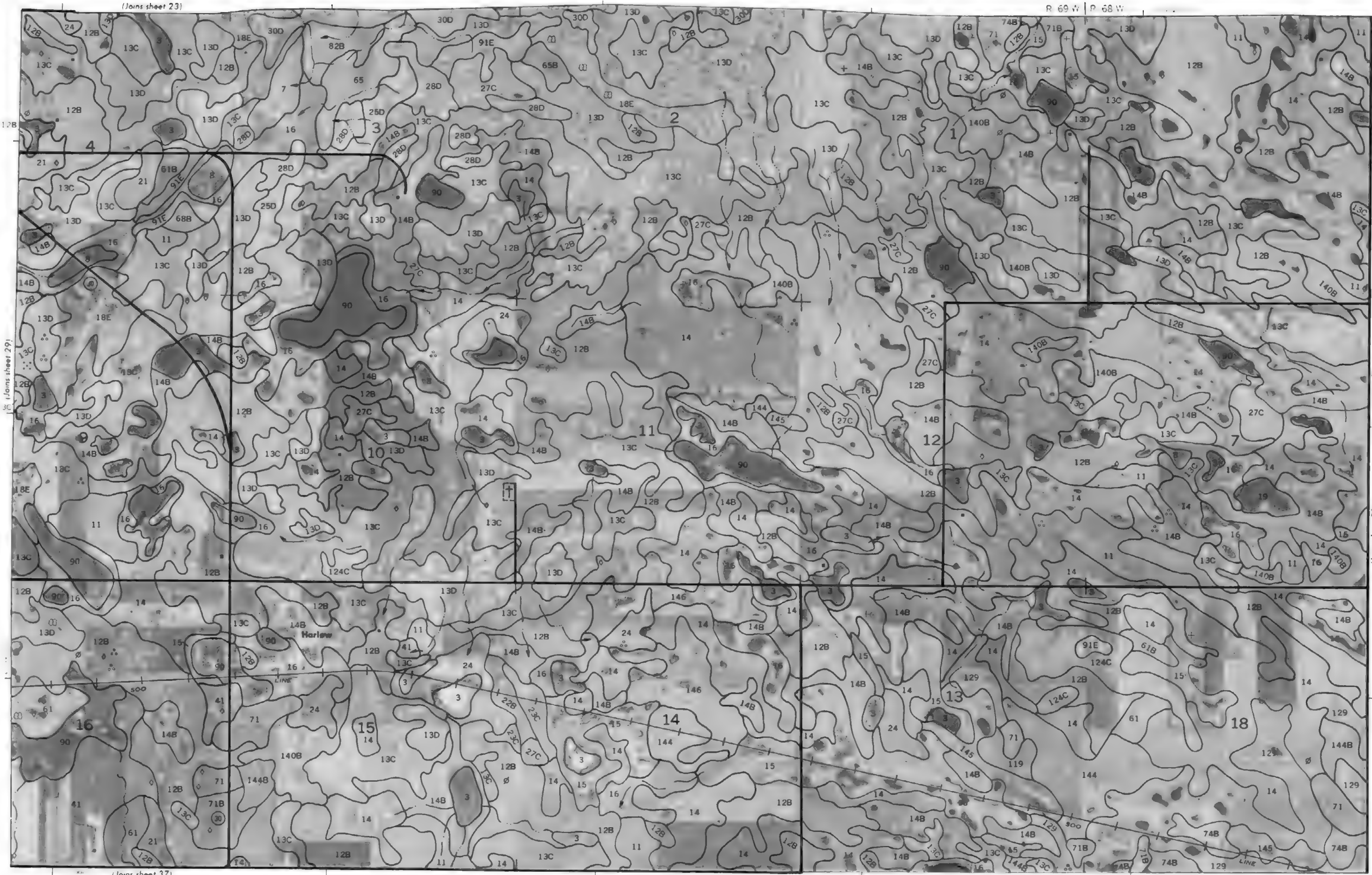




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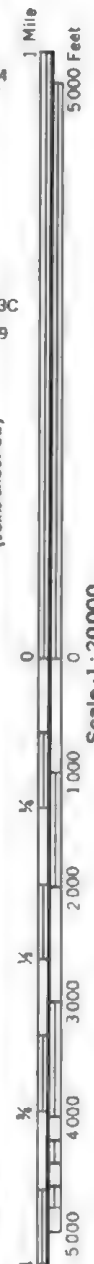
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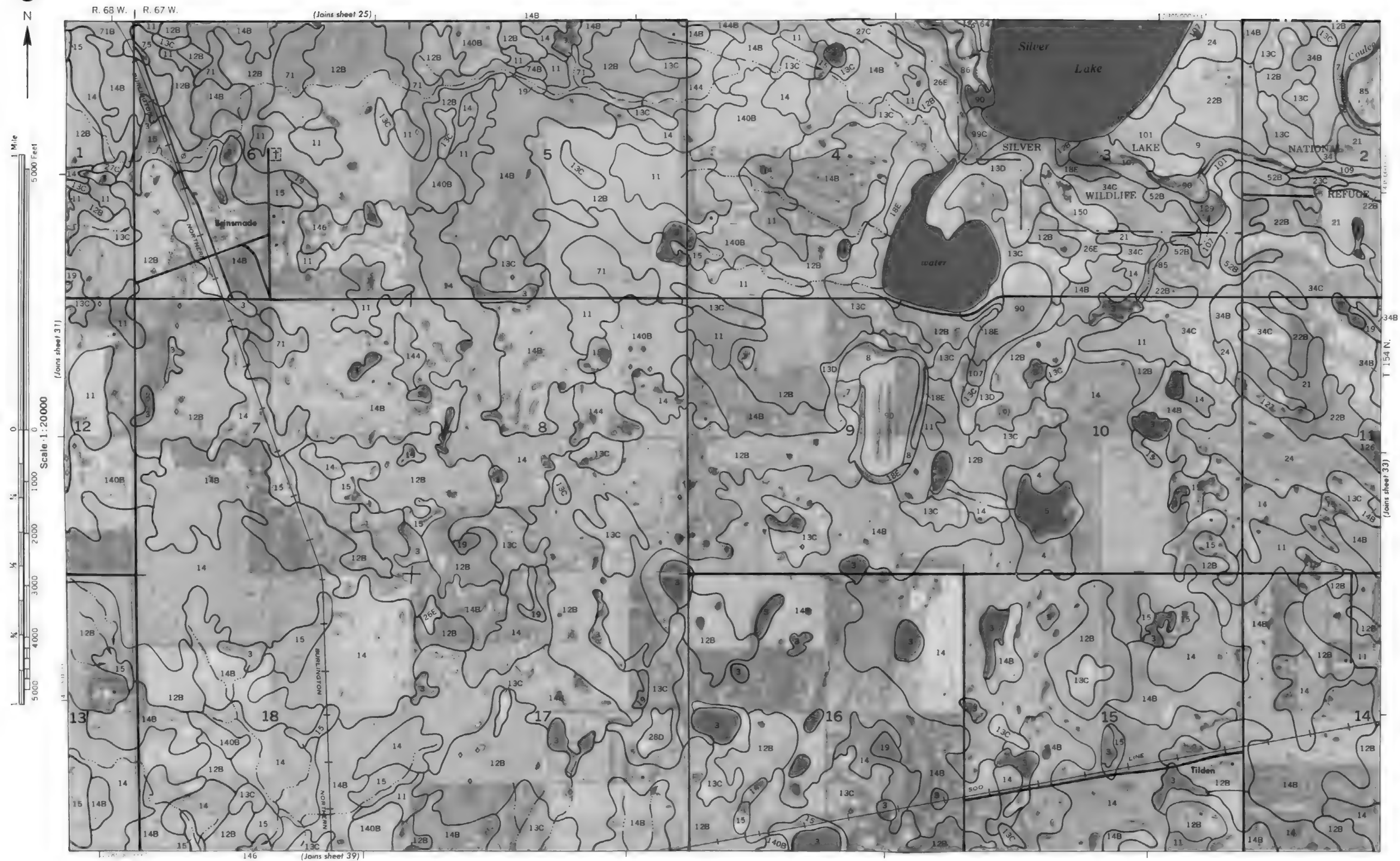
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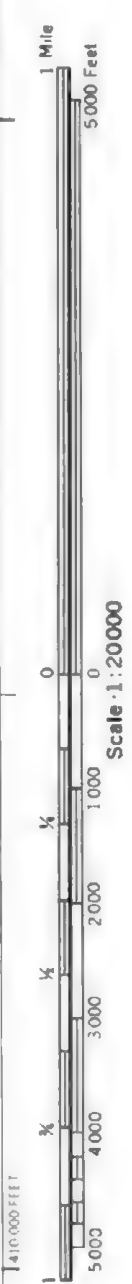


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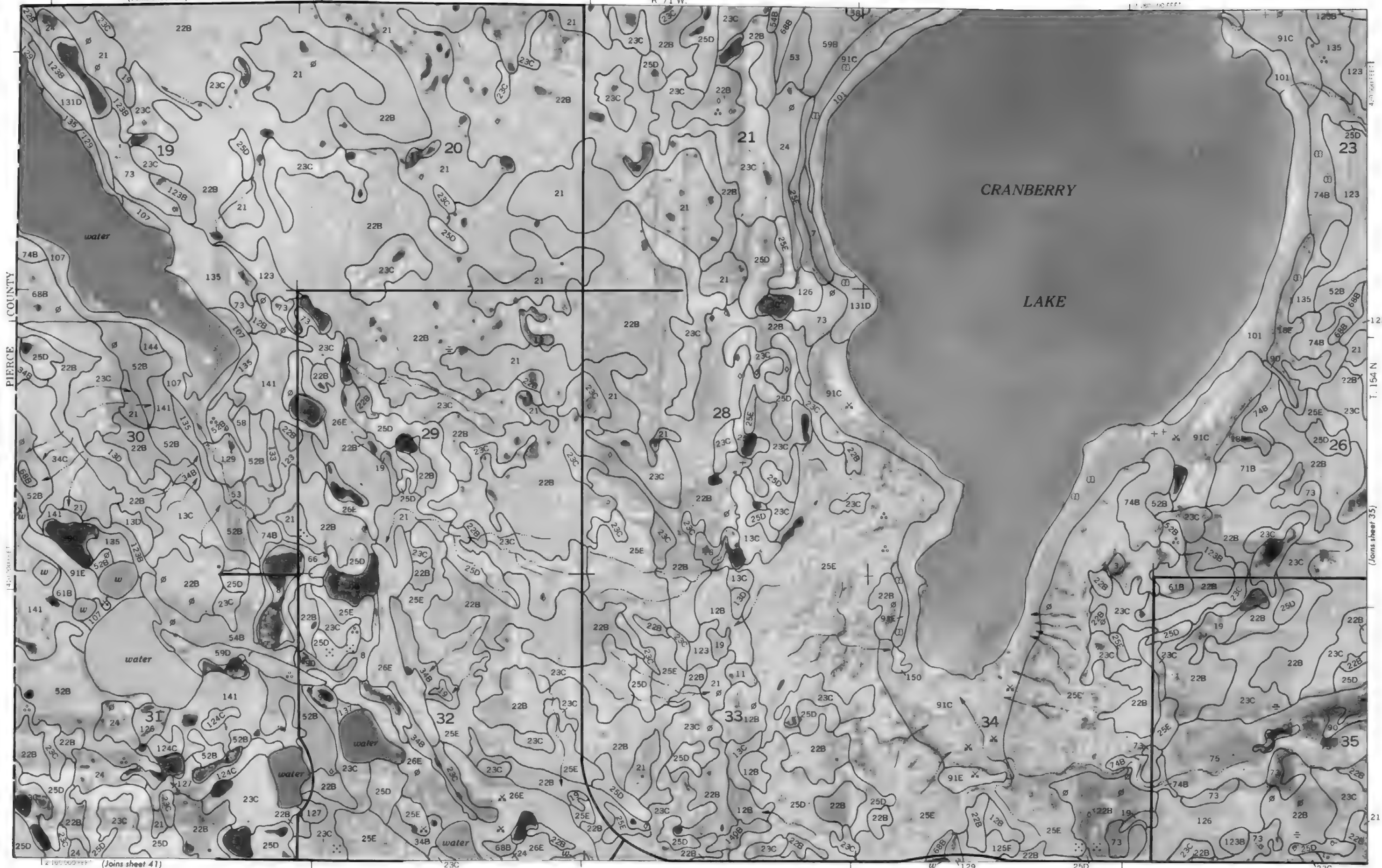
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T. 154 N.

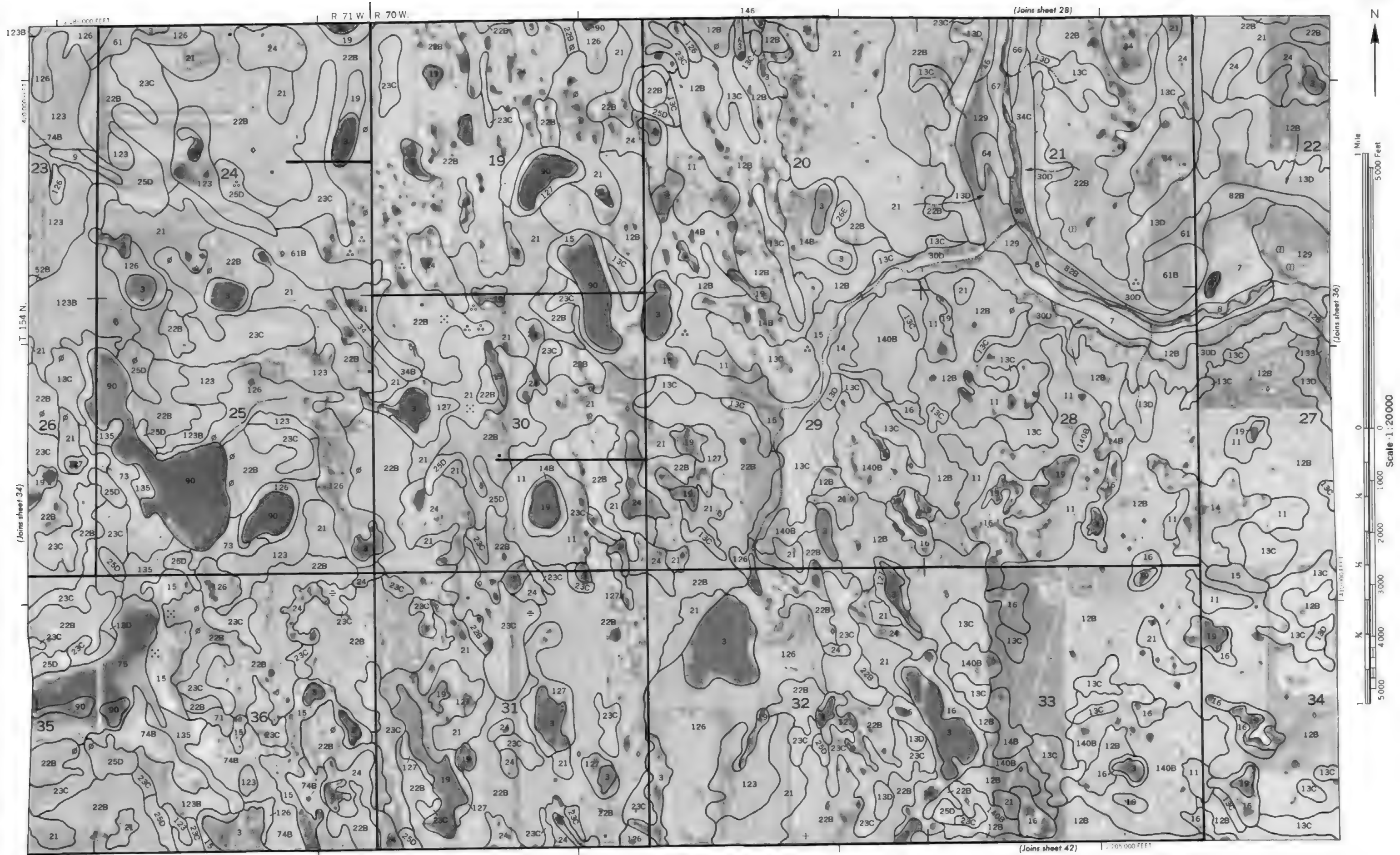


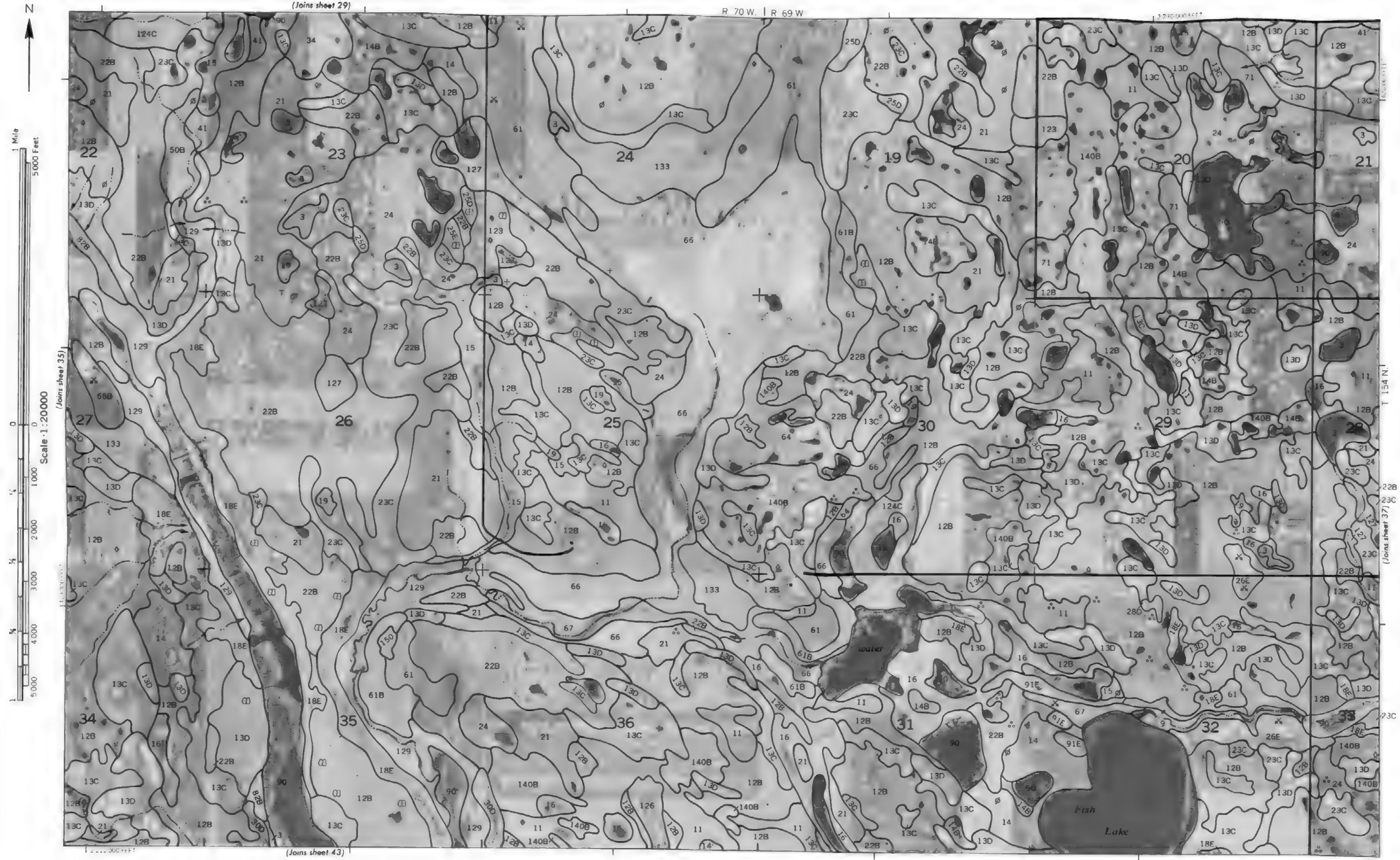
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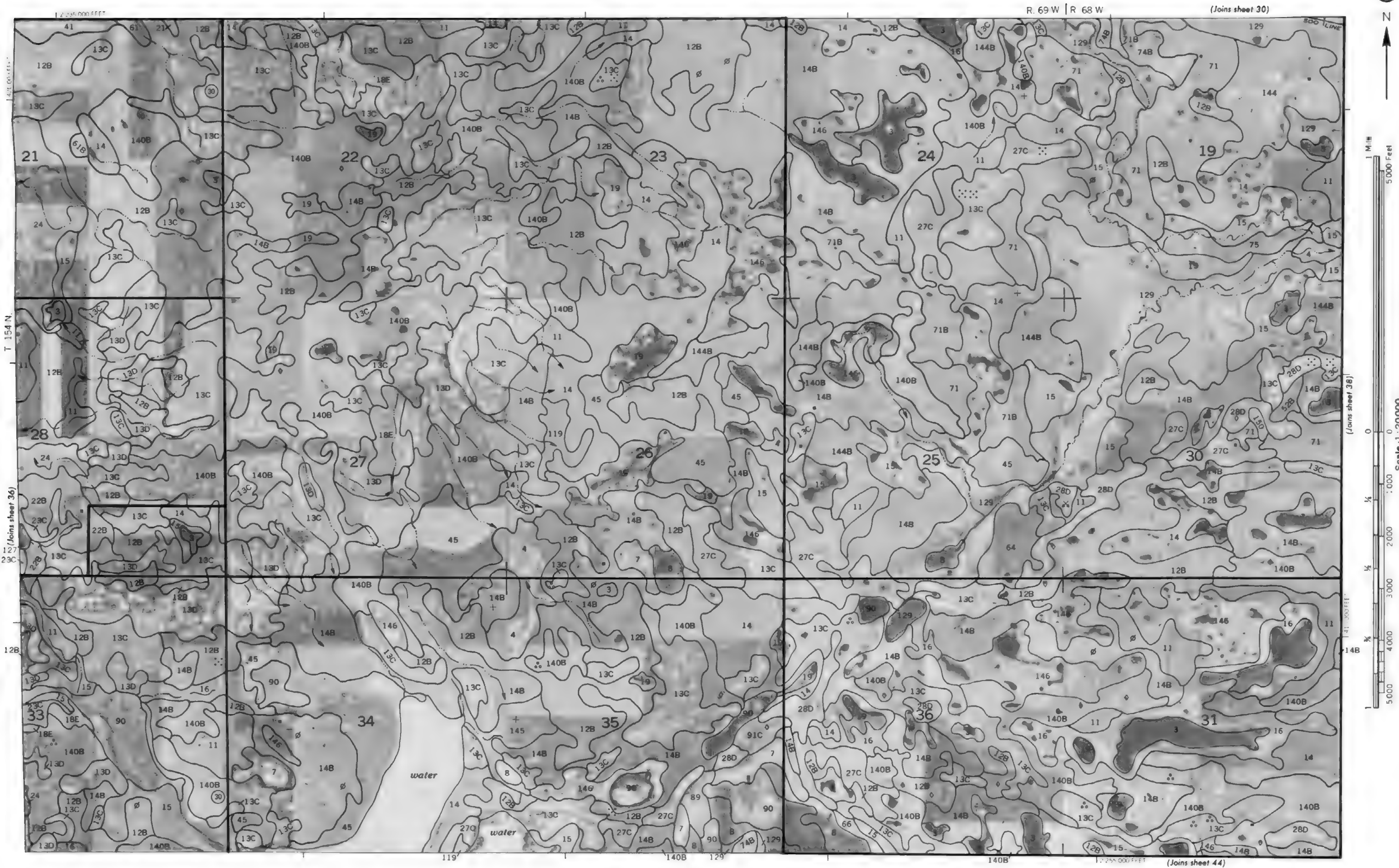


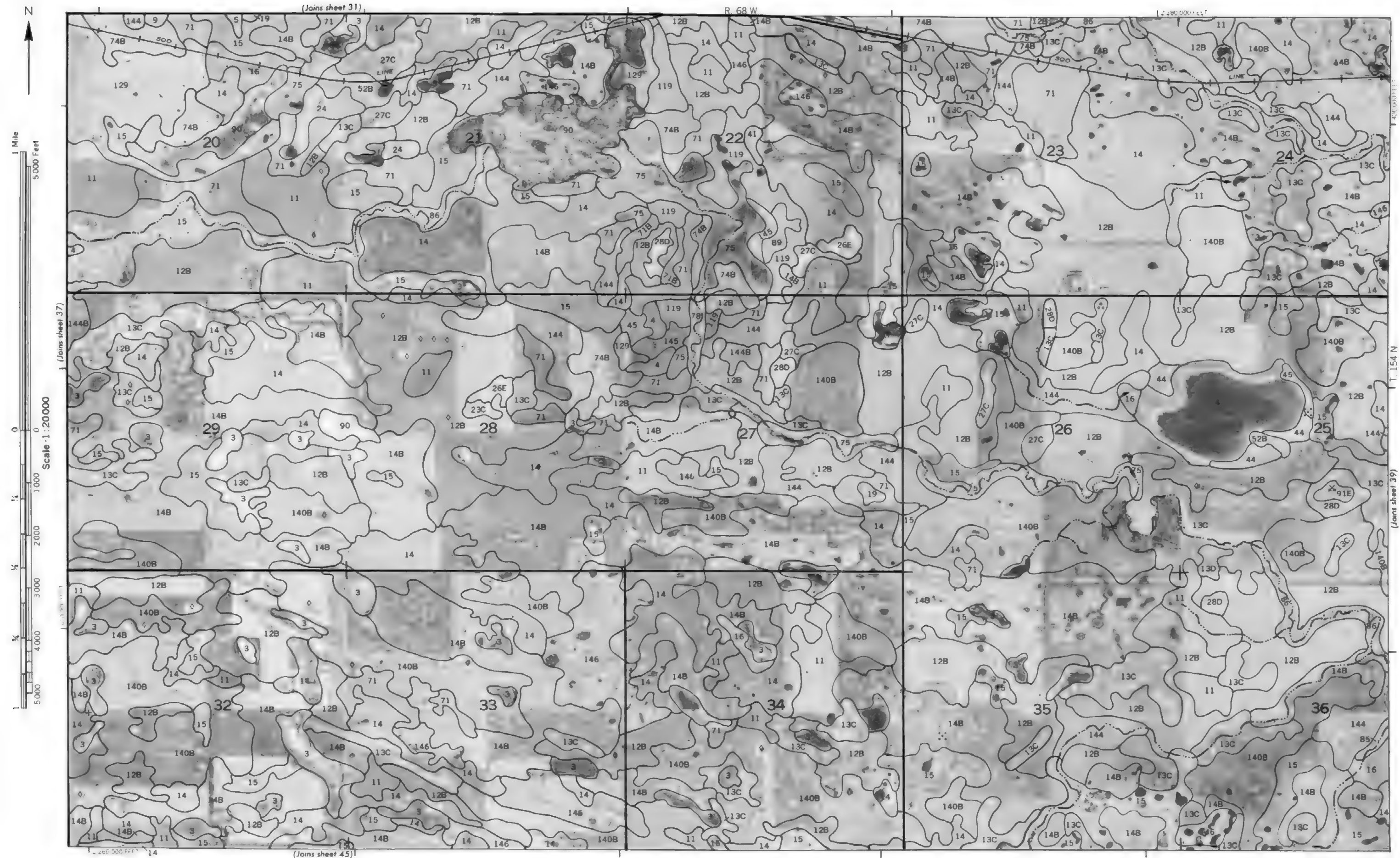
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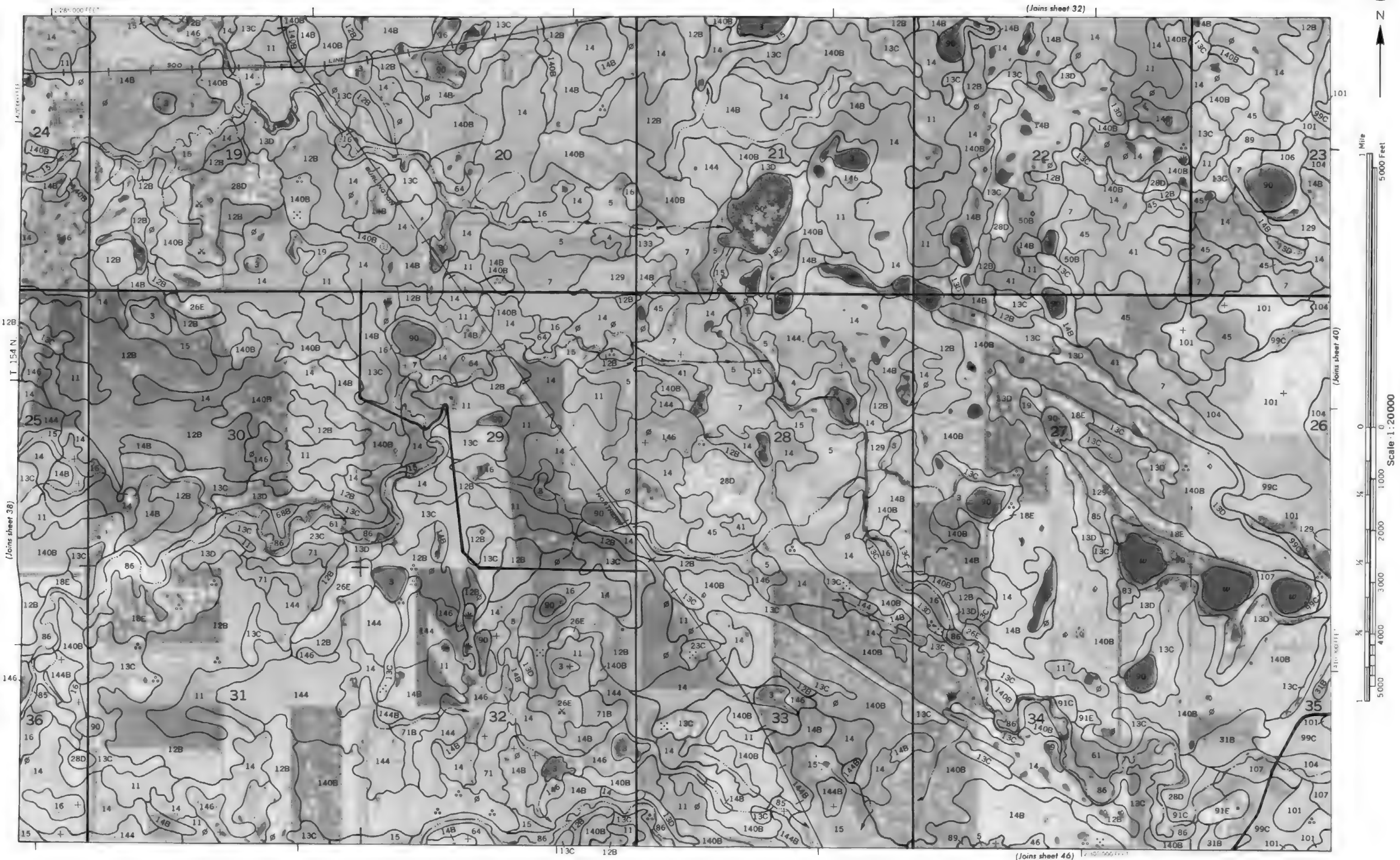
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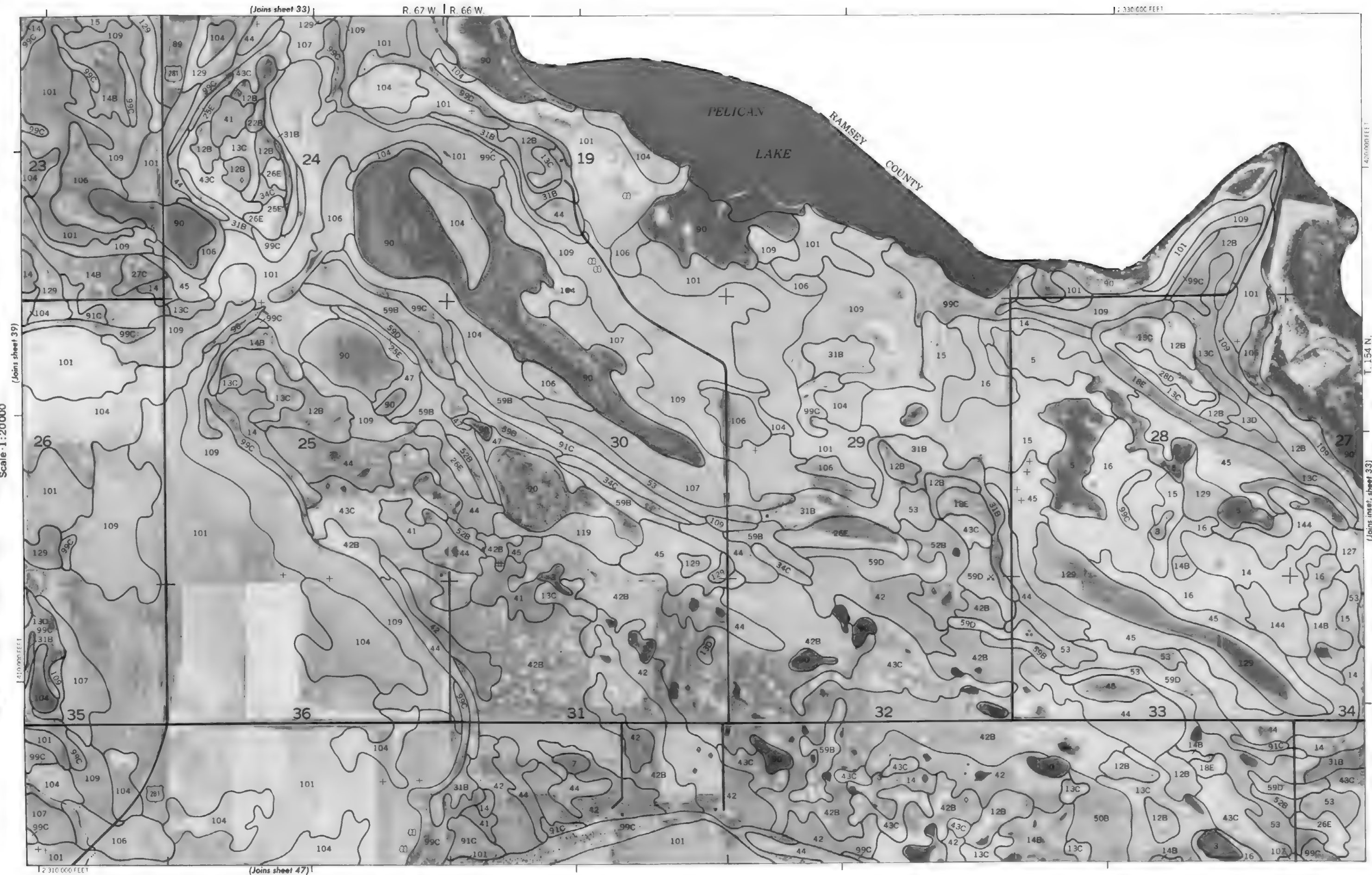
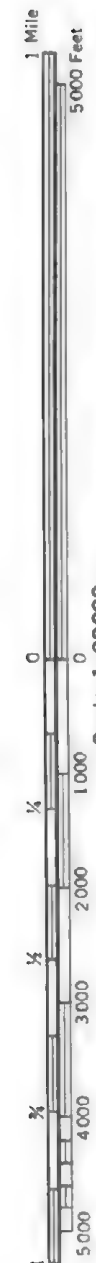


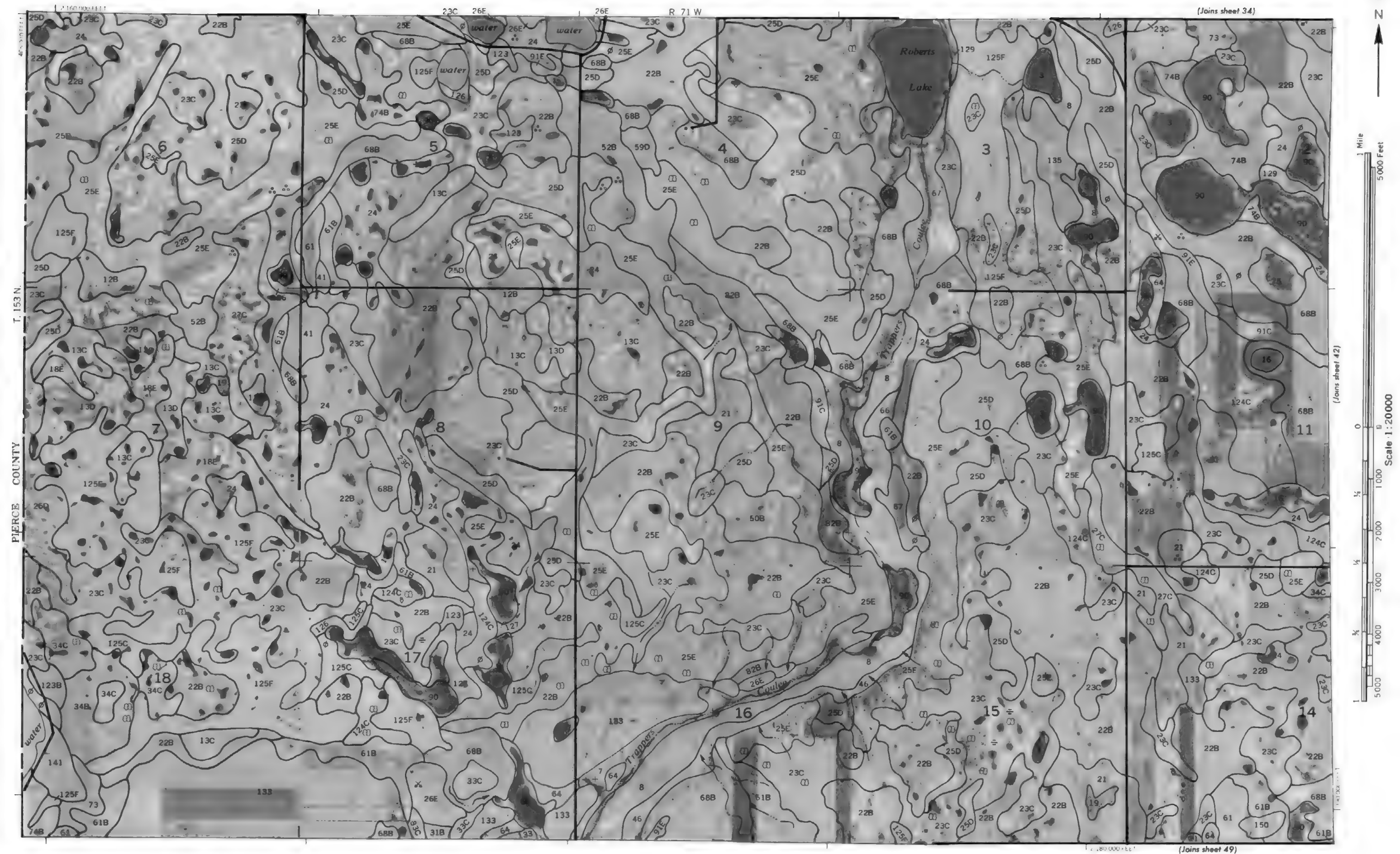


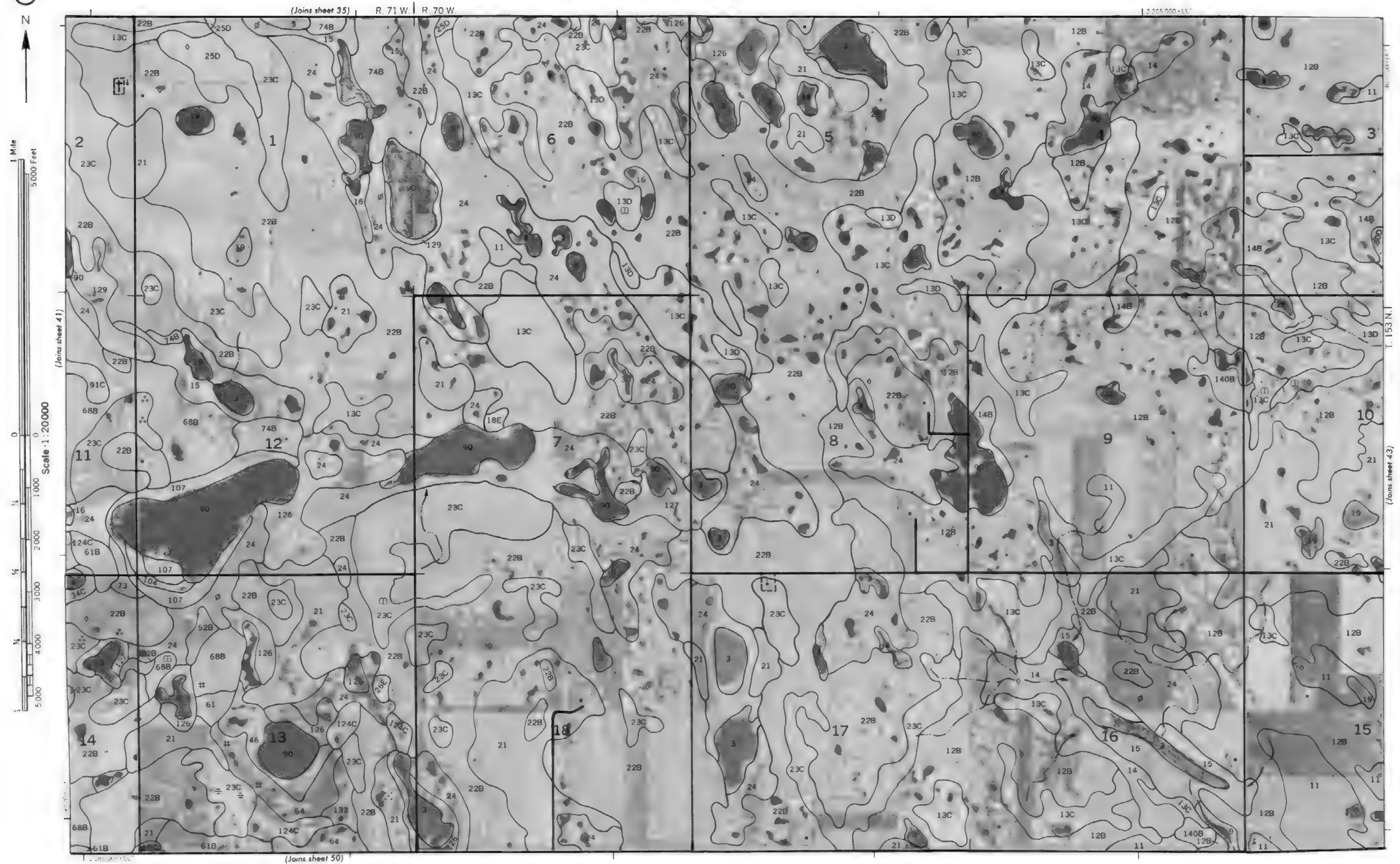


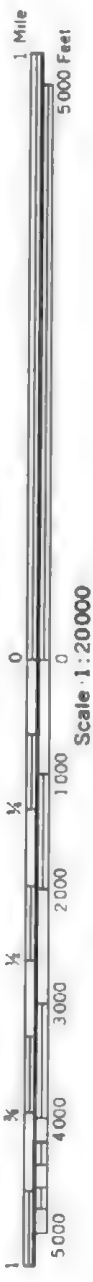








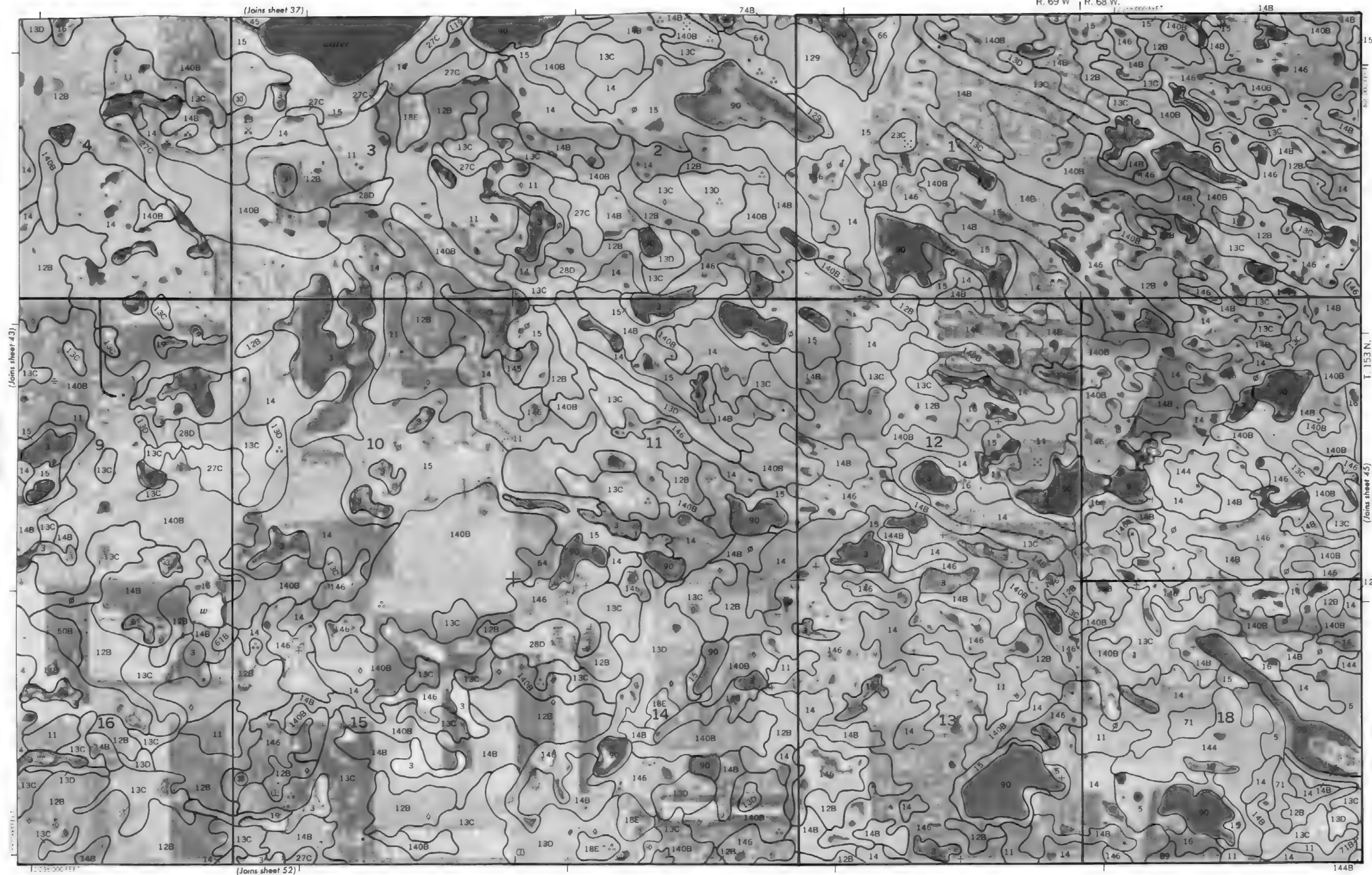


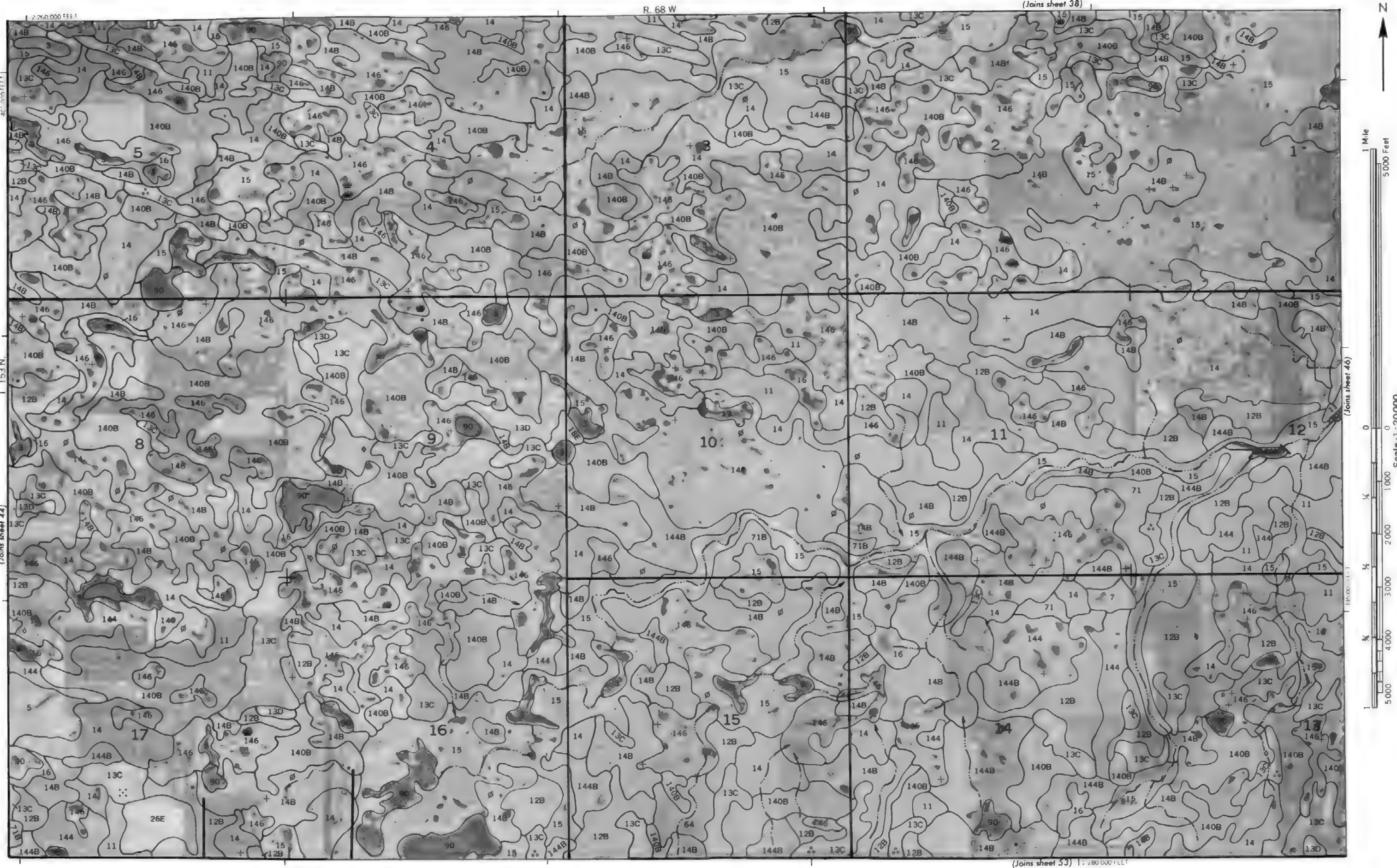


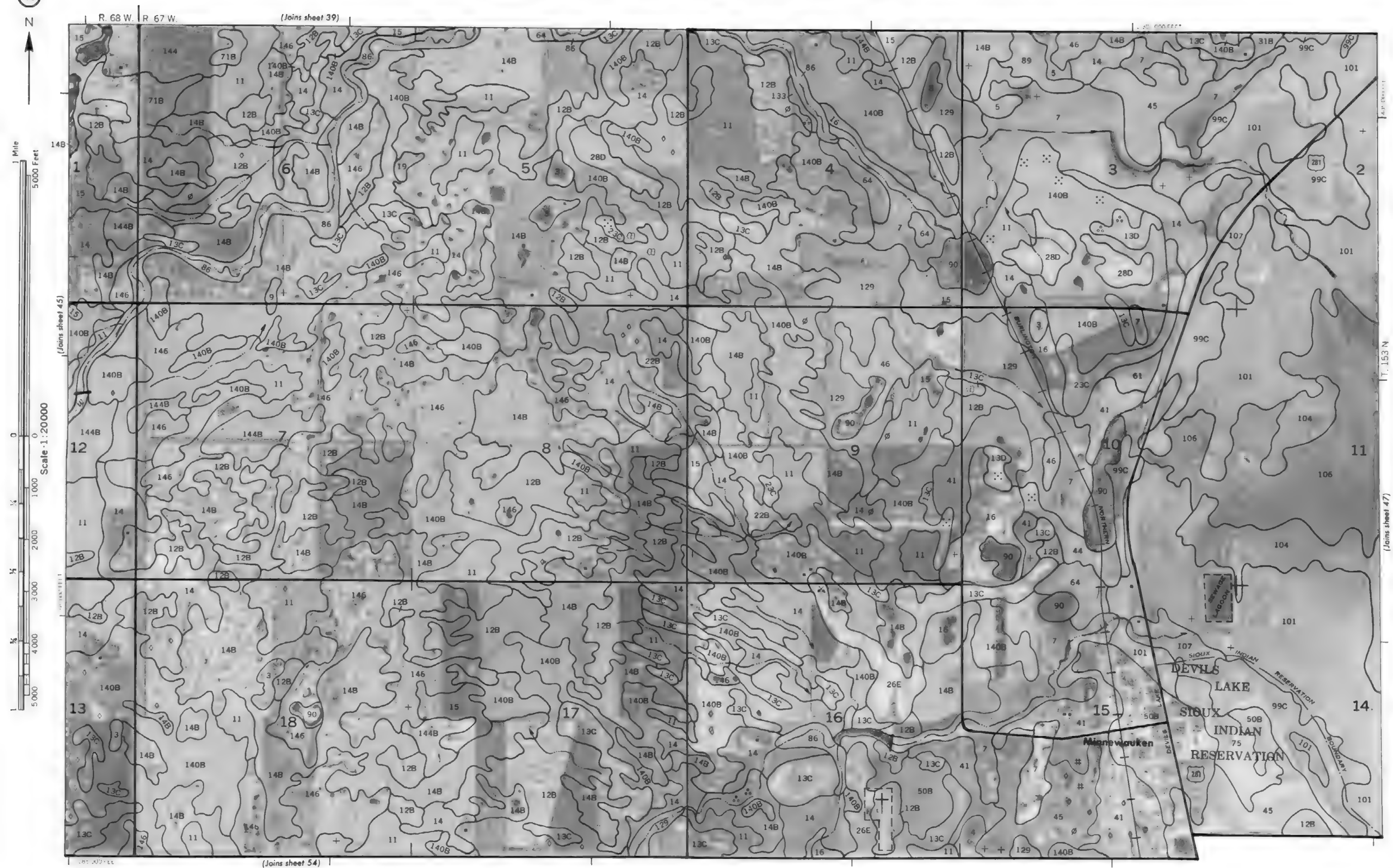


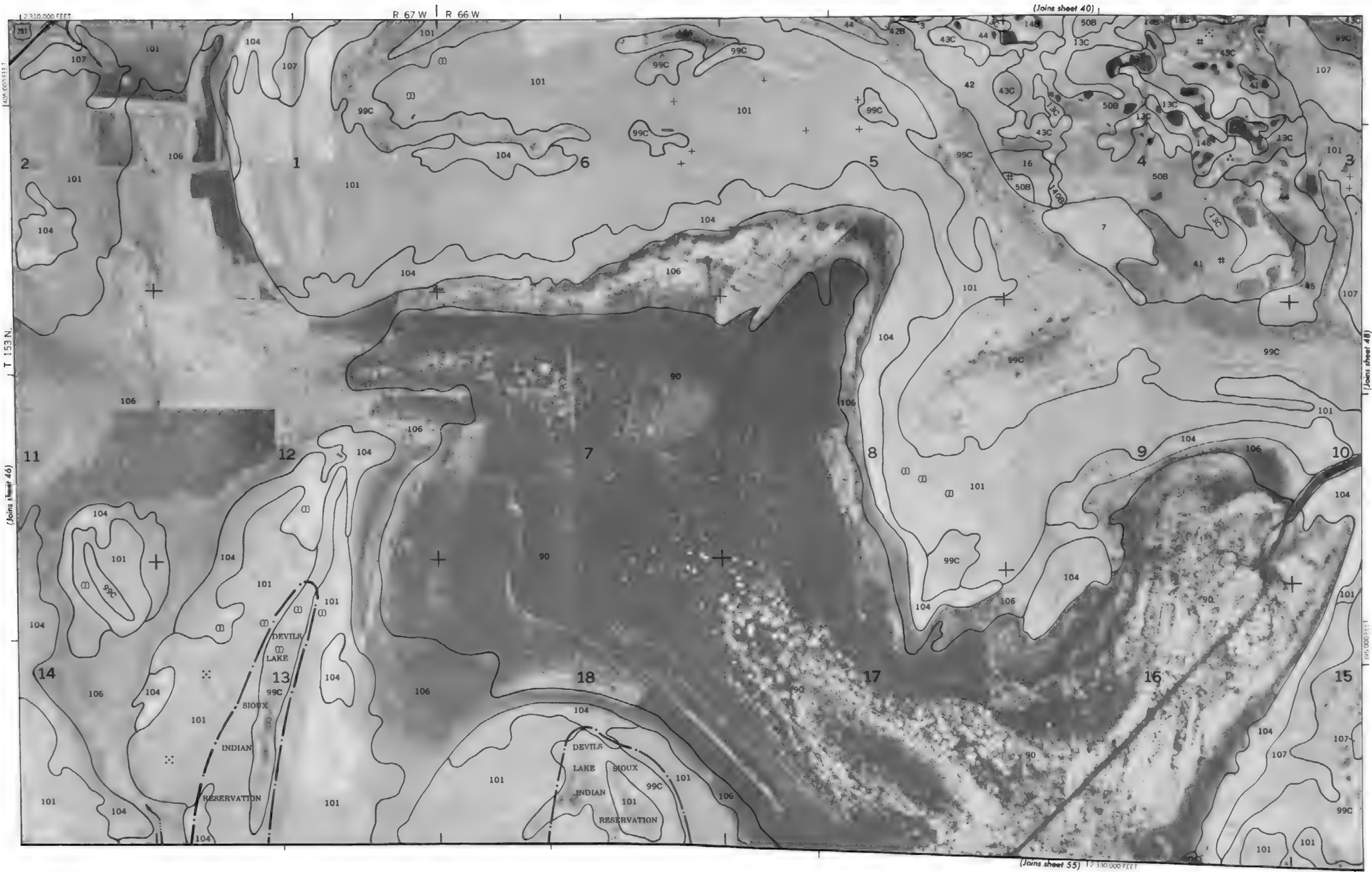
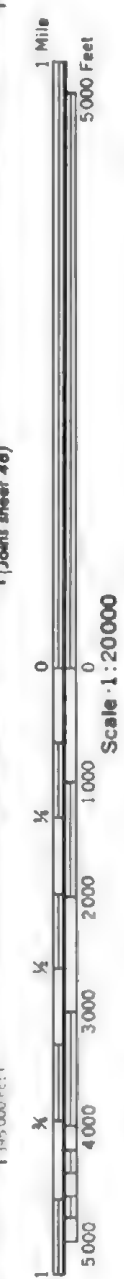
1 Mile
5000 Feet

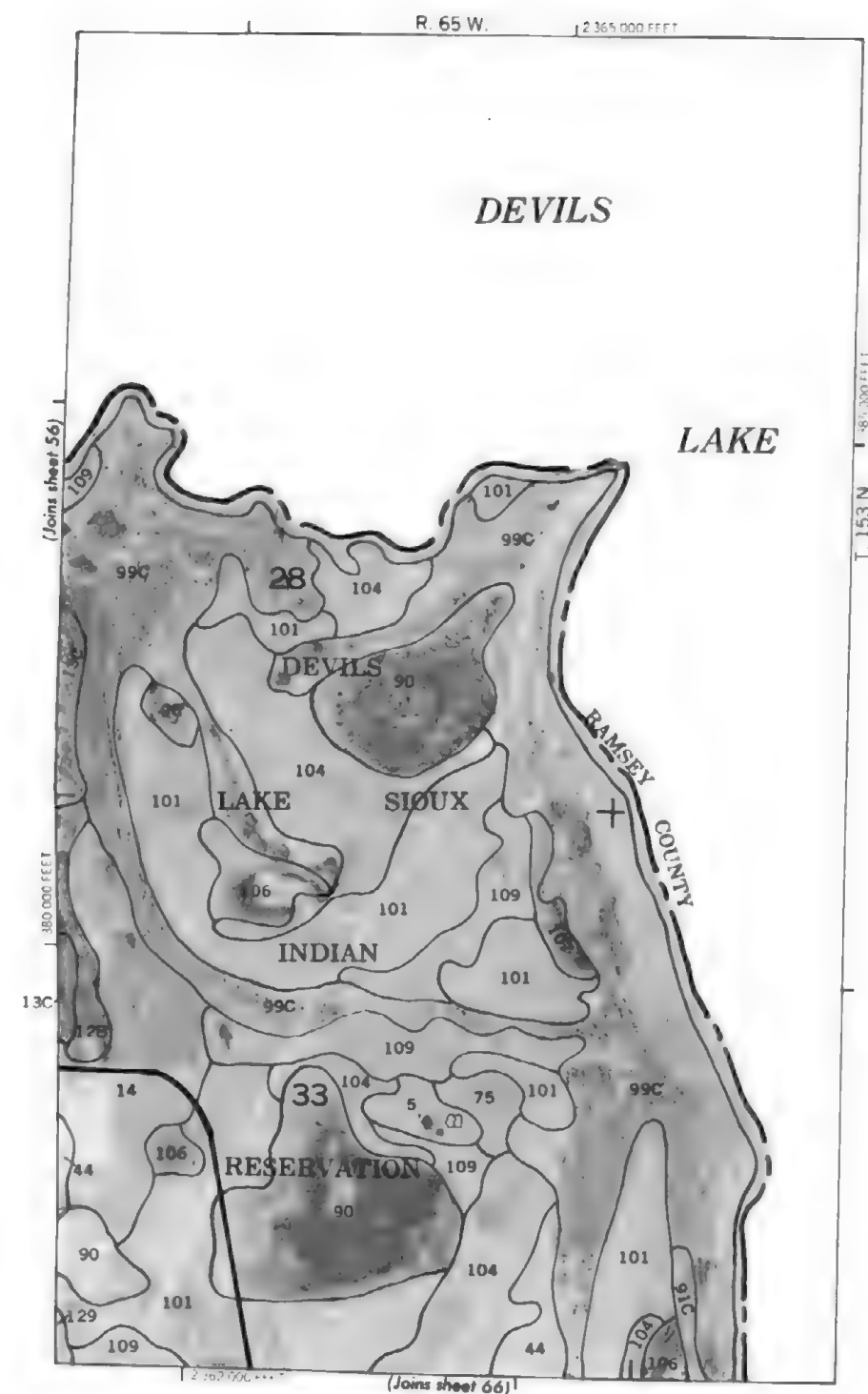
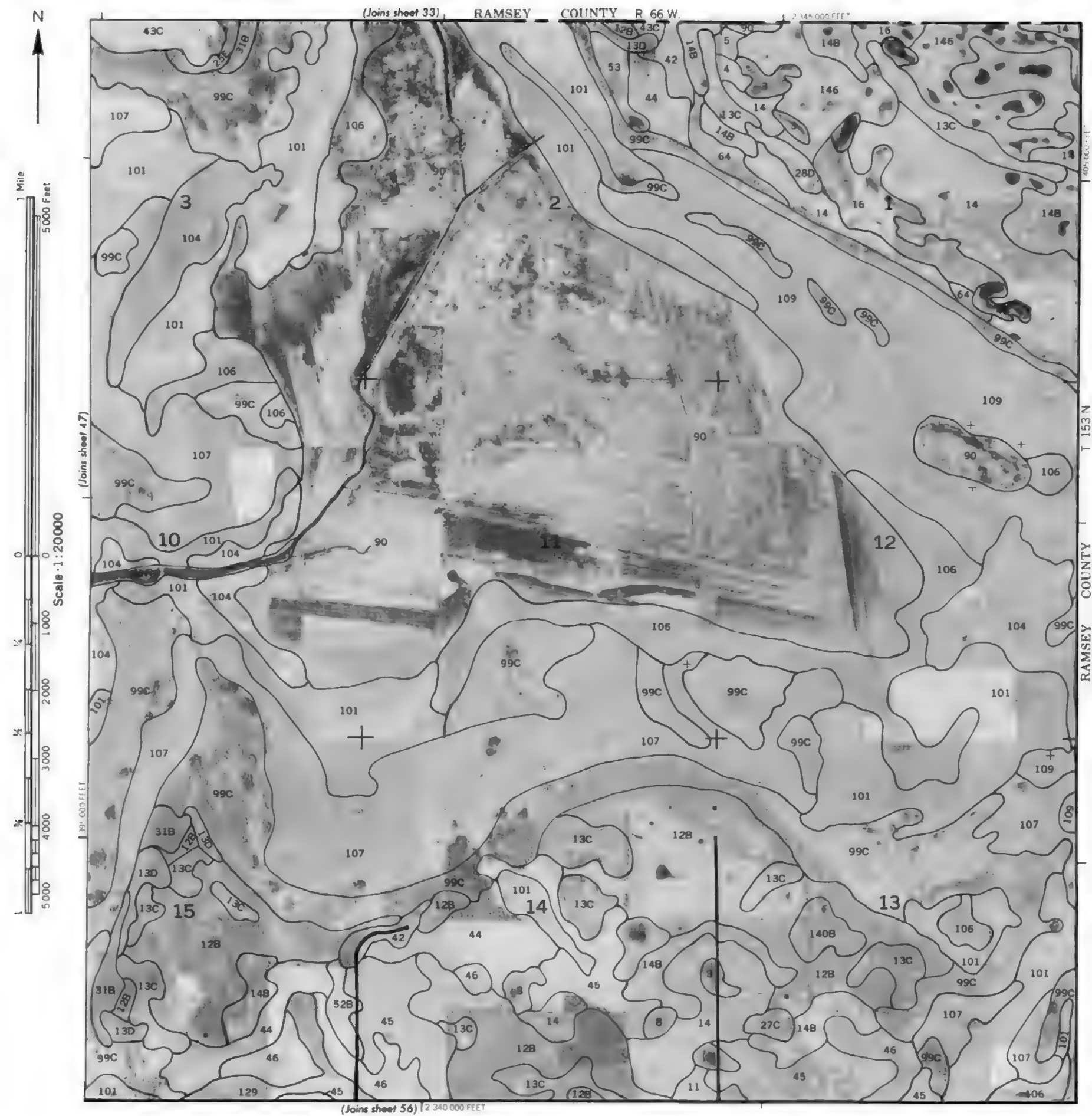
Scale 1:20000



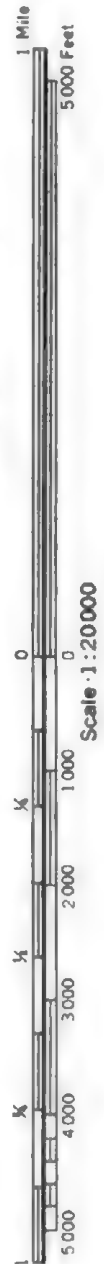




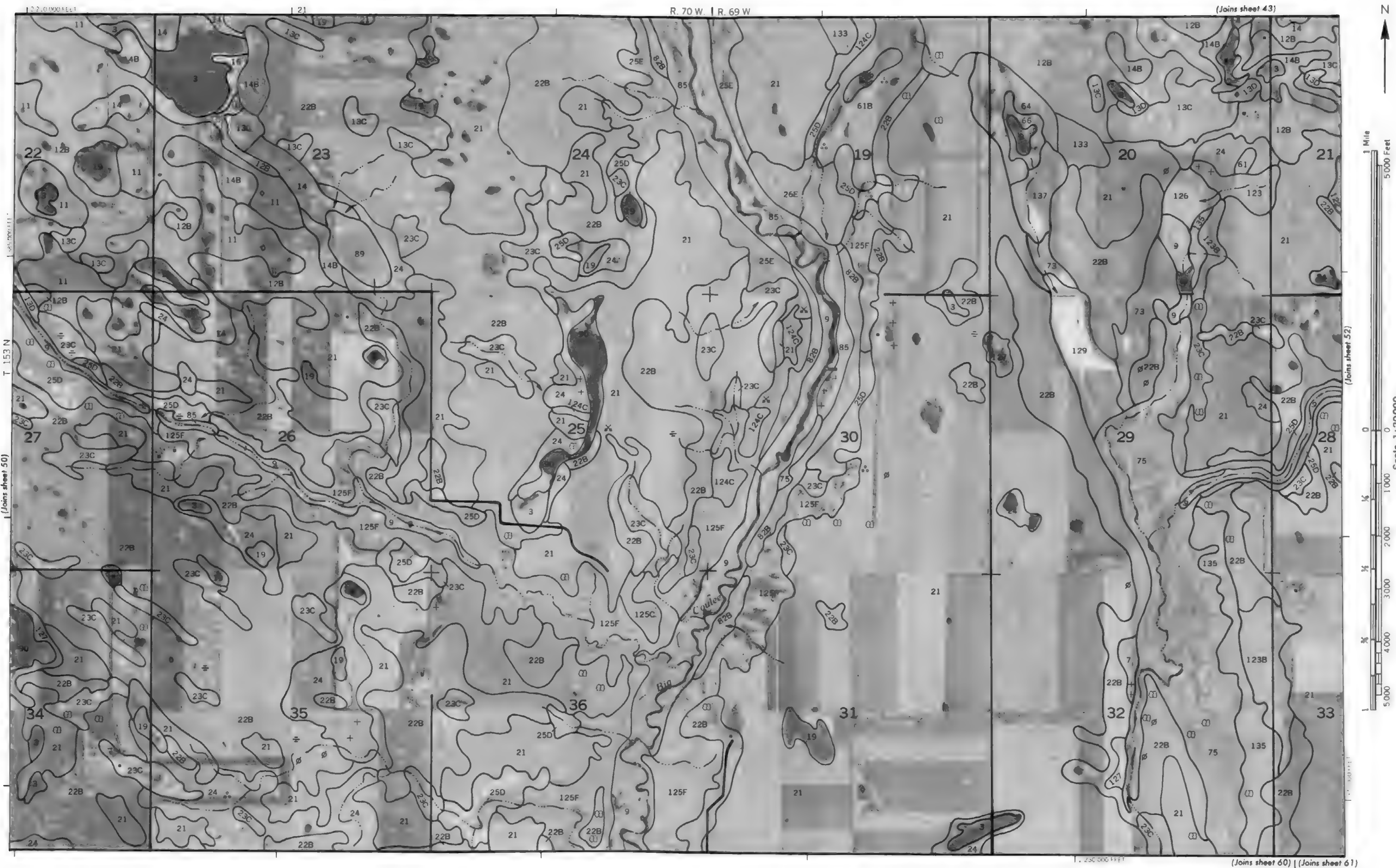




(Joins sheet 41)



Scale · 1 : 20 000



(Joins sheet 44)

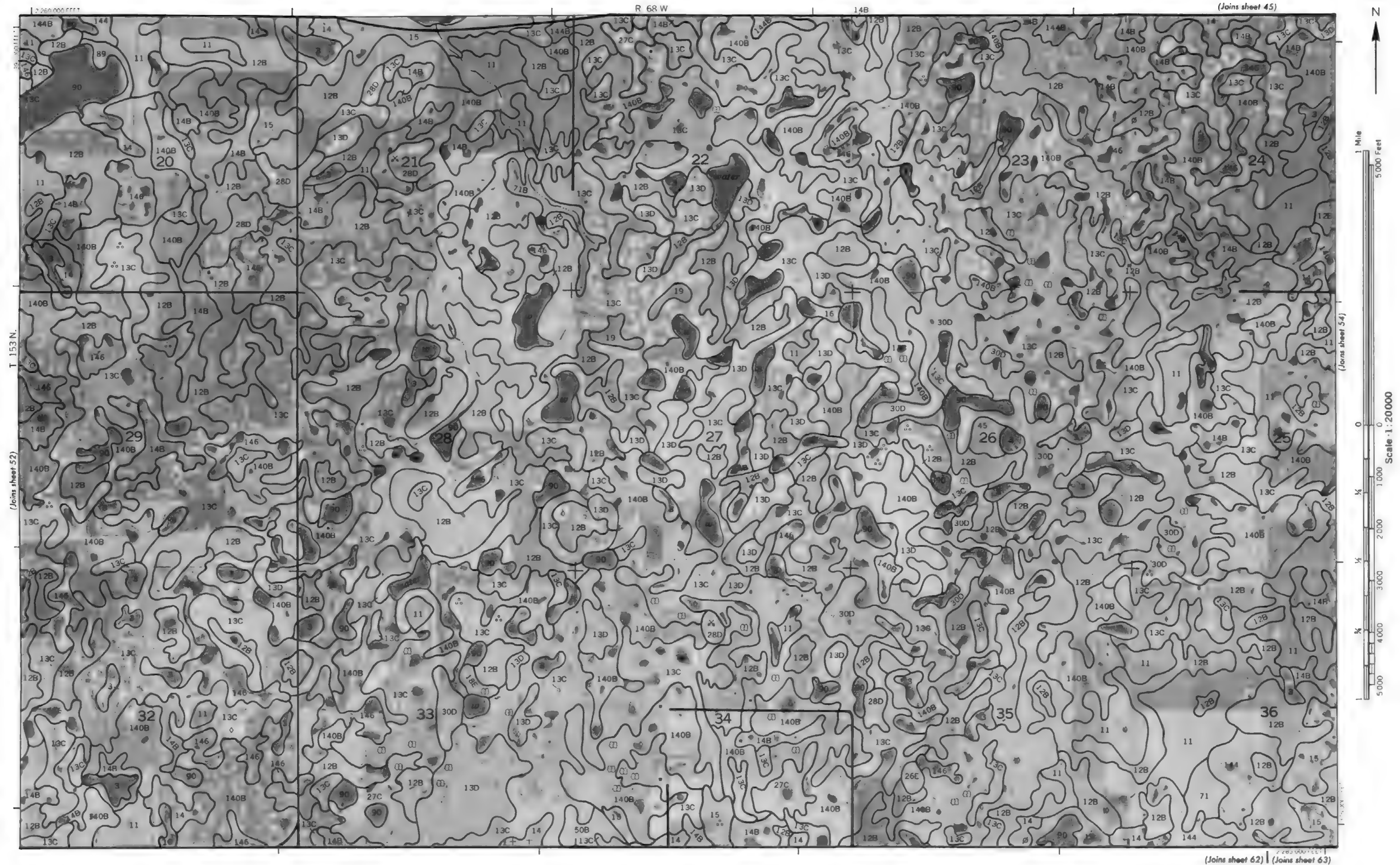


Scale 1:20000

(Joins sheet 51)

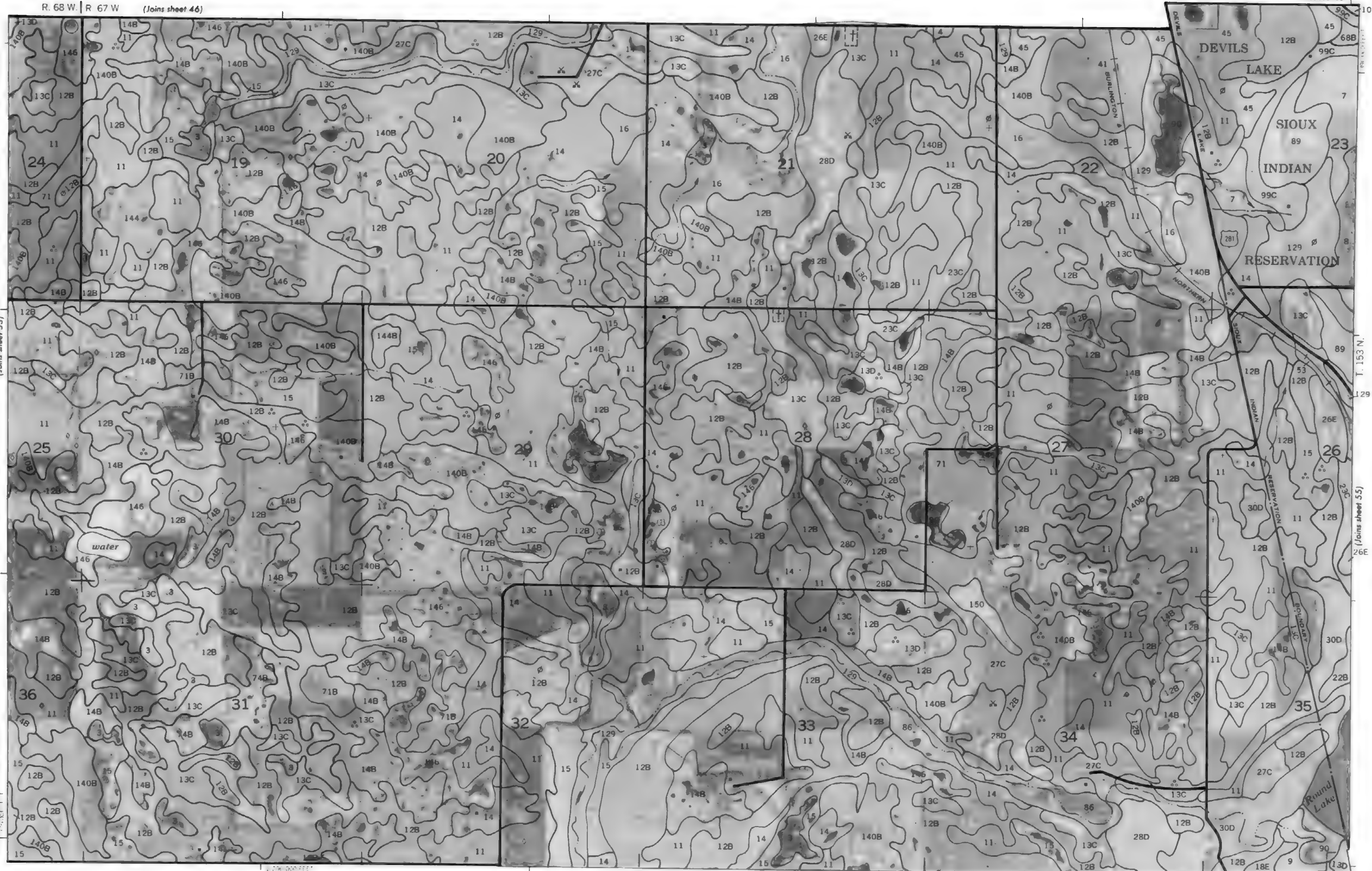


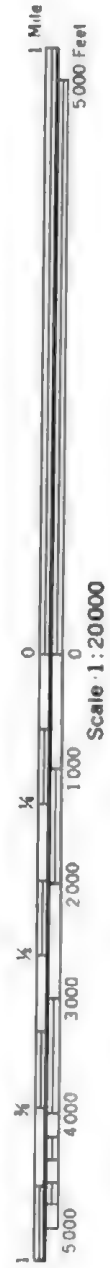
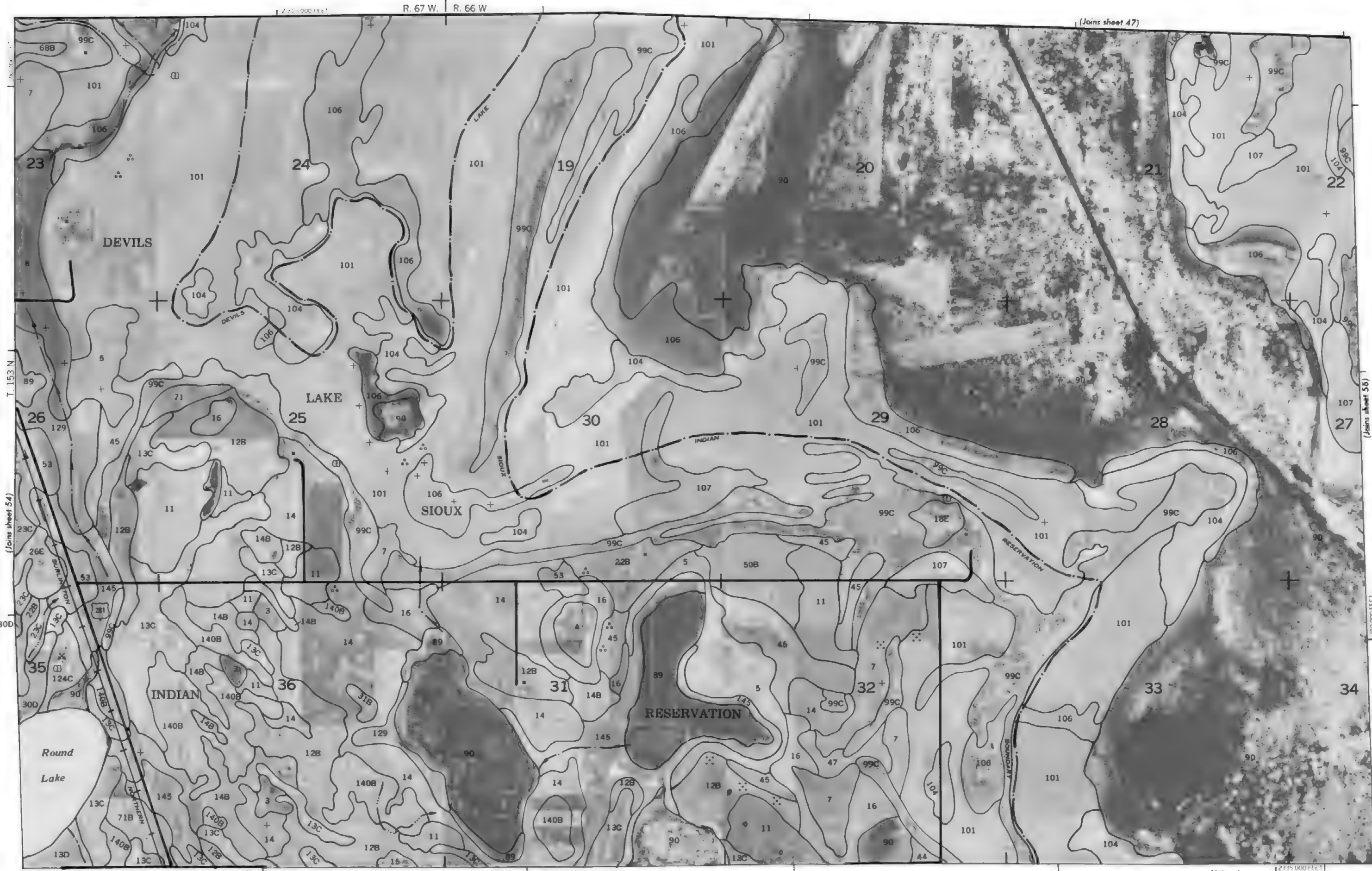
(Joins sheet 53)





R. 68 W. | R. 67 W (Joins sheet 46)







N

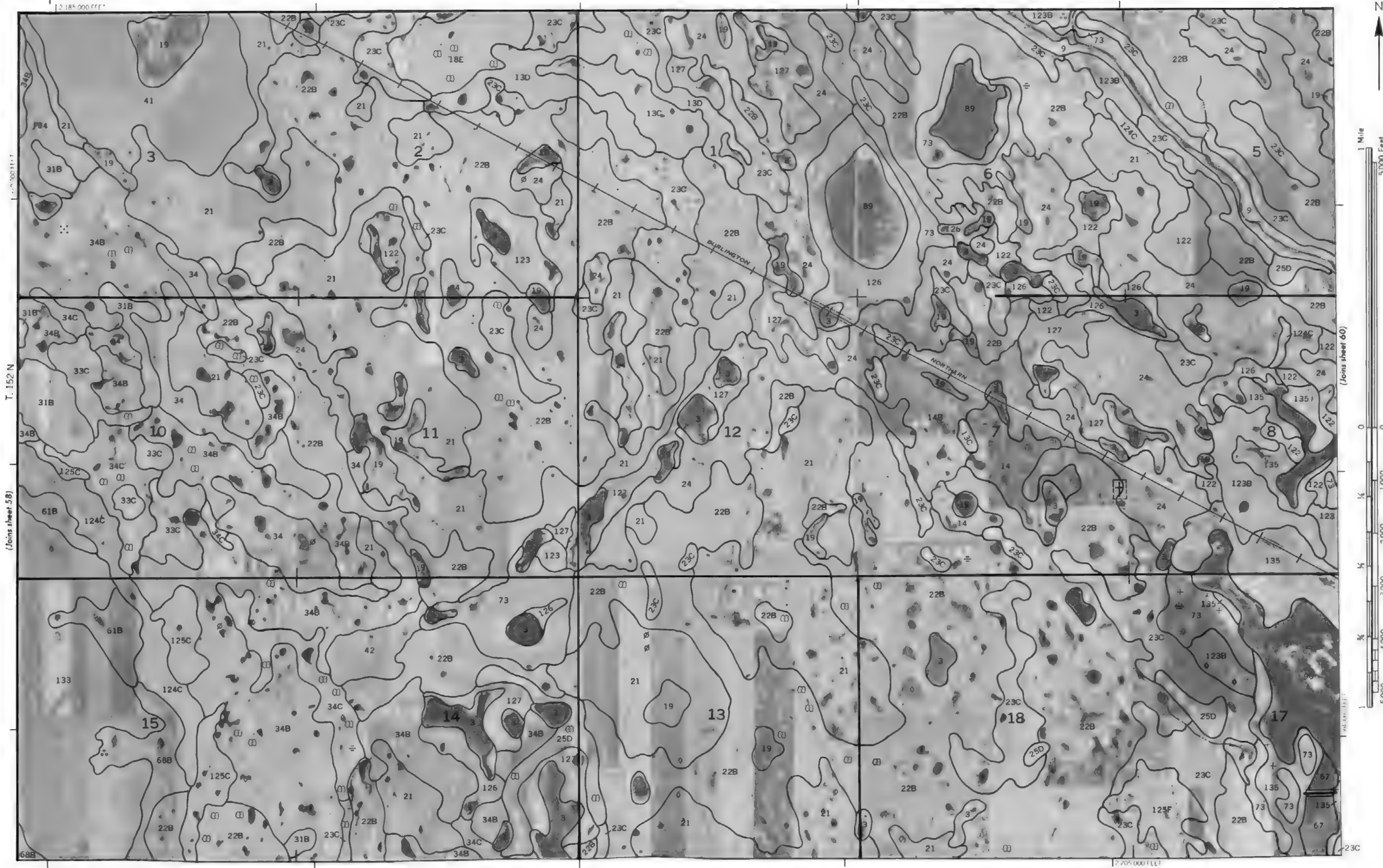


2420 000 FEET

(Joins sheet 49) (Joins sheet 50)

R. 71 W. | R. 70 W.

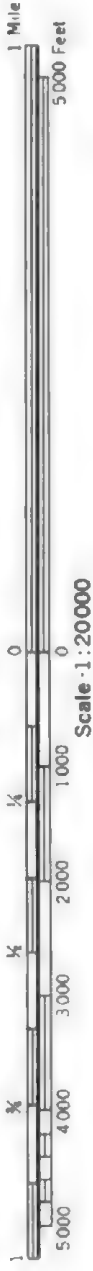
2 185 000 F.F.T.



T. 152 N

(Joins sheet 58)

(Joins sheet 60)



2 205 000 F.F.T.

12240000





(Joins sheet 51) (Joins sheet 52)

T 152 N.

(Joins sheet 60)

(Joins sheet 62)

(Joins sheet 73)



(Joins sheet 52) (Joins sheet 53)

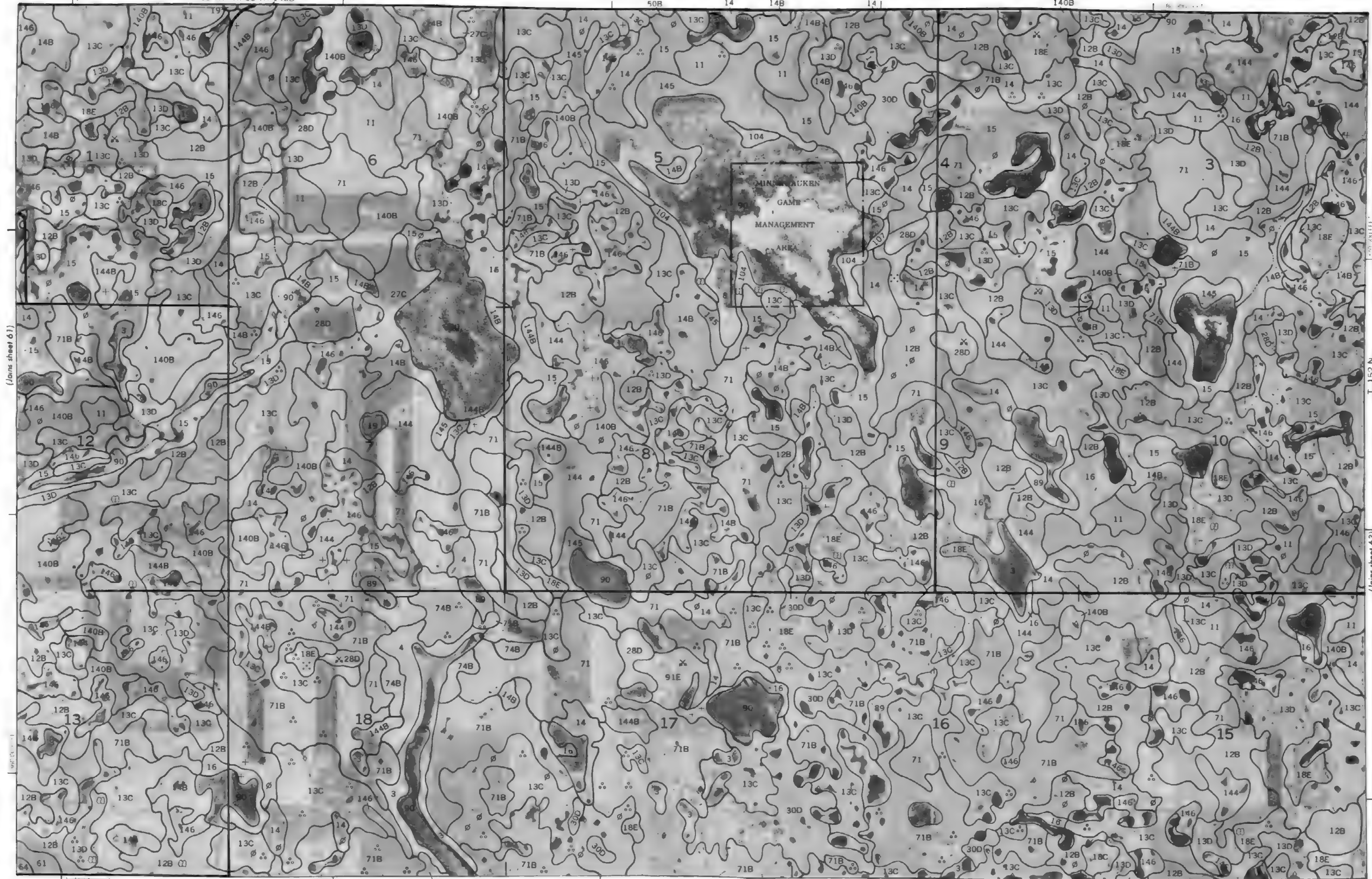
R. 69 W. R. 68 W. 140B

50B 14 14B 141 140B



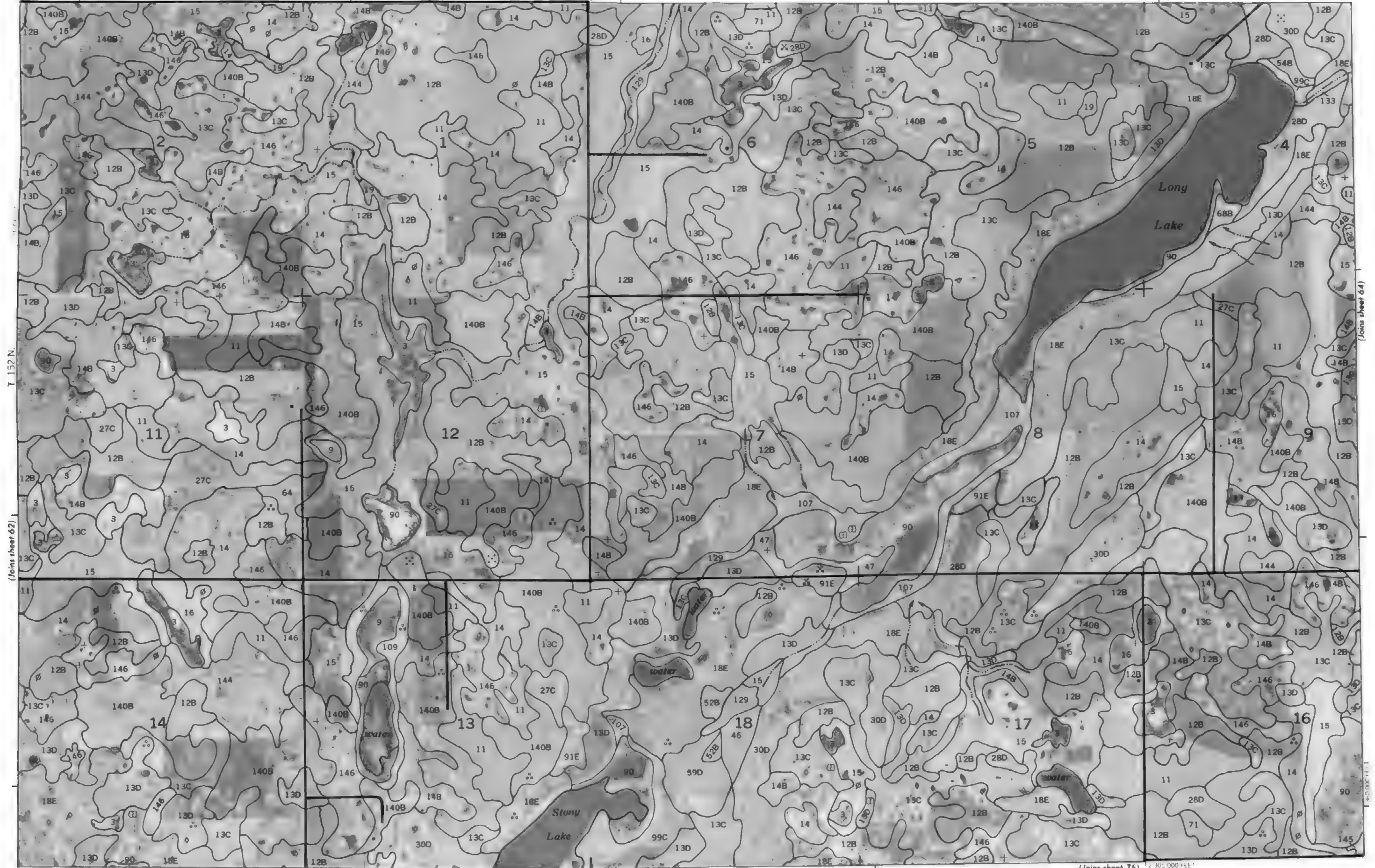
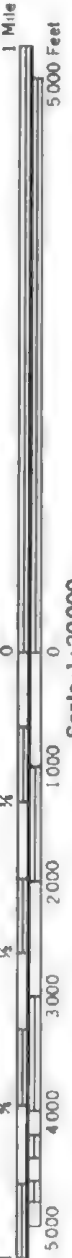
(Joins sheet 61)

Scale 1:20000



(Joins sheet 53) (Joins sheet 54)

R. 68 W. R. 67 W.



T. 152 N.

(Joins sheet 62)

(Joins sheet 64)

(Joins sheet 75)

(Joins sheet 54) (Joins sheet 55)

R 67 W R 66 W

2 310 000 FEET



Scale: 1:20000

(Joins sheet 63)



(Joins sheet 65)

T. 152 N.

2 310 000 FEET

(Joins sheet 76)

R. 66 W. | R. 65 W

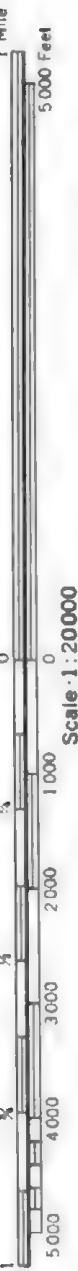


(Joins sheet 77)

(Joins sheet 56) (Joins inset, sheet 48)

R. 65 W.

12 380 000 FEET



375 000 FEET

T 152 N

(Joins sheet 67)

12 360 000 FEET

(Joins sheet 78)

130

98E

(Joins sheet 57)

2 384 000 FEET

Polymer Letters, 7, 69 (1969)

T. 152 N.

(Joins sheet 66)

5 000 Feet

1

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20 20

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400

5005

0
Scale-1:20000

(Joins sheet 79) 1:405 000 FEET

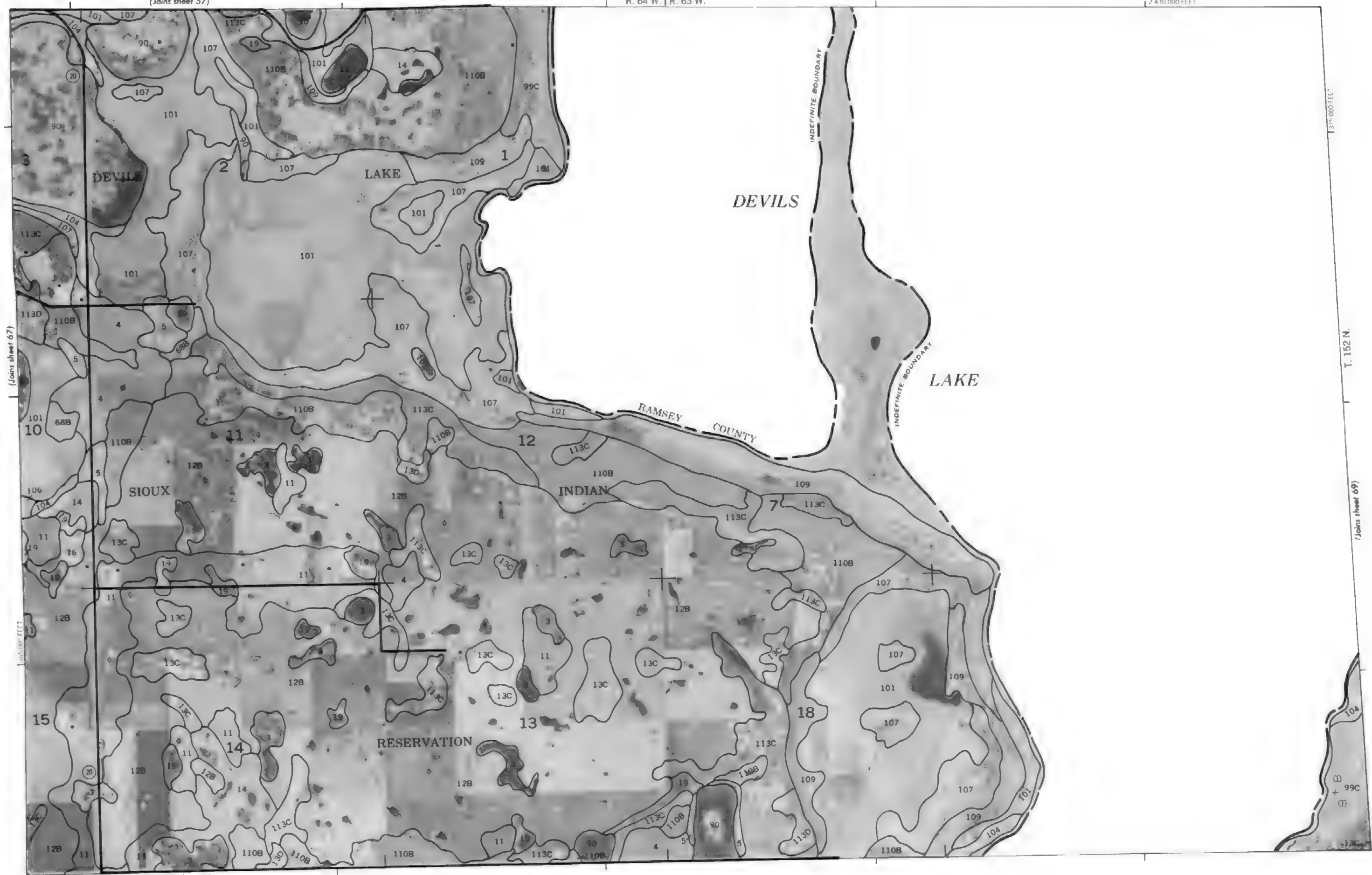
(Joins sheet 57)

R. 64 W. | R. 63 W.

2 430 000 FEET



Scale 1:20,000



376 000 FEET

T. 152 N.

(Joins sheet 69)

(Joins sheet 80)

Scale - 1:20000



Scale-1: 20000

(Joins sheet 81)

(Joins sheet 58)

R. 71 W

2 180 000 FEET

1 Mile
5 000 Feet

Scale 1:20000



PIERCE COUNTY

PIERCE COUNTY

2 180 000 FEET

T. 152 N.

(Joins sheet 71)

2 160 000 FEET

(Joins sheet 82)

R 71 W. R. 70 W.

(Joins sheet 59)

71



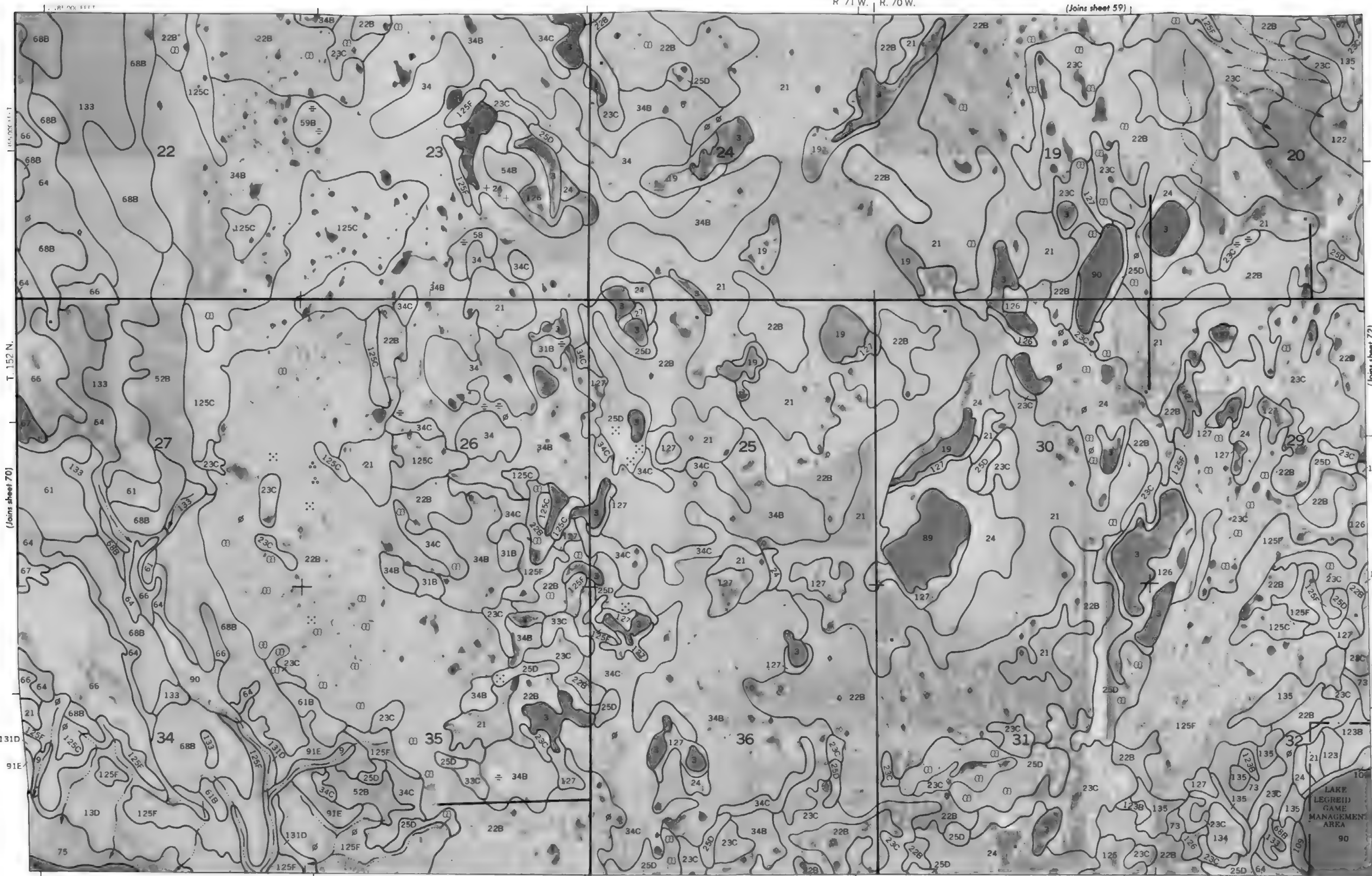
1 Mile
5000 Feet

Scale 1:20000

(Joins sheet 72)

(Joins sheet 83)

LAKE
LEGREID
GAME
MANAGEMENT
AREA



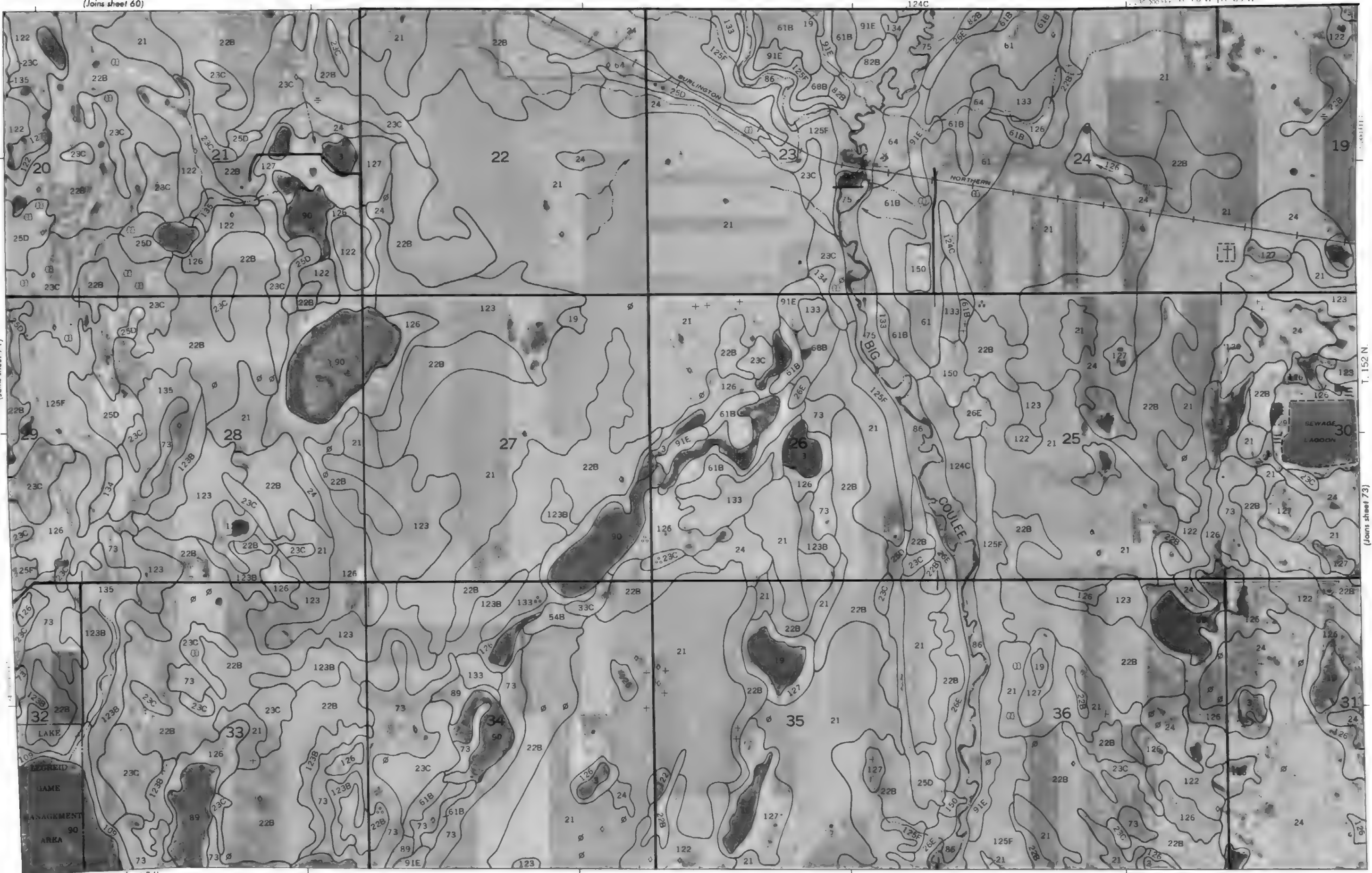


(Joins sheet 60)

R 70 W | R 69 W



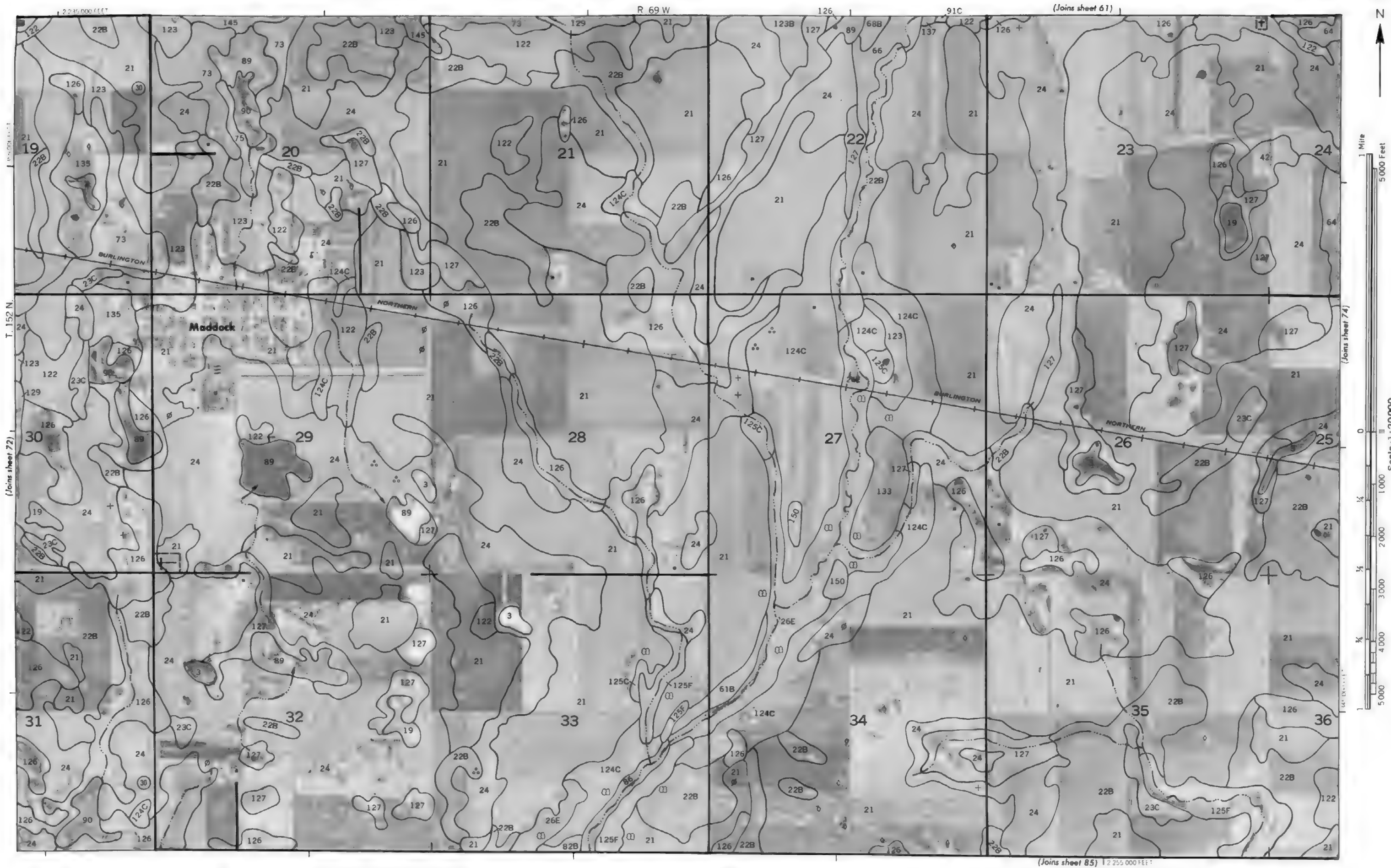
(Joins sheet 71)



(Joins sheet 84)

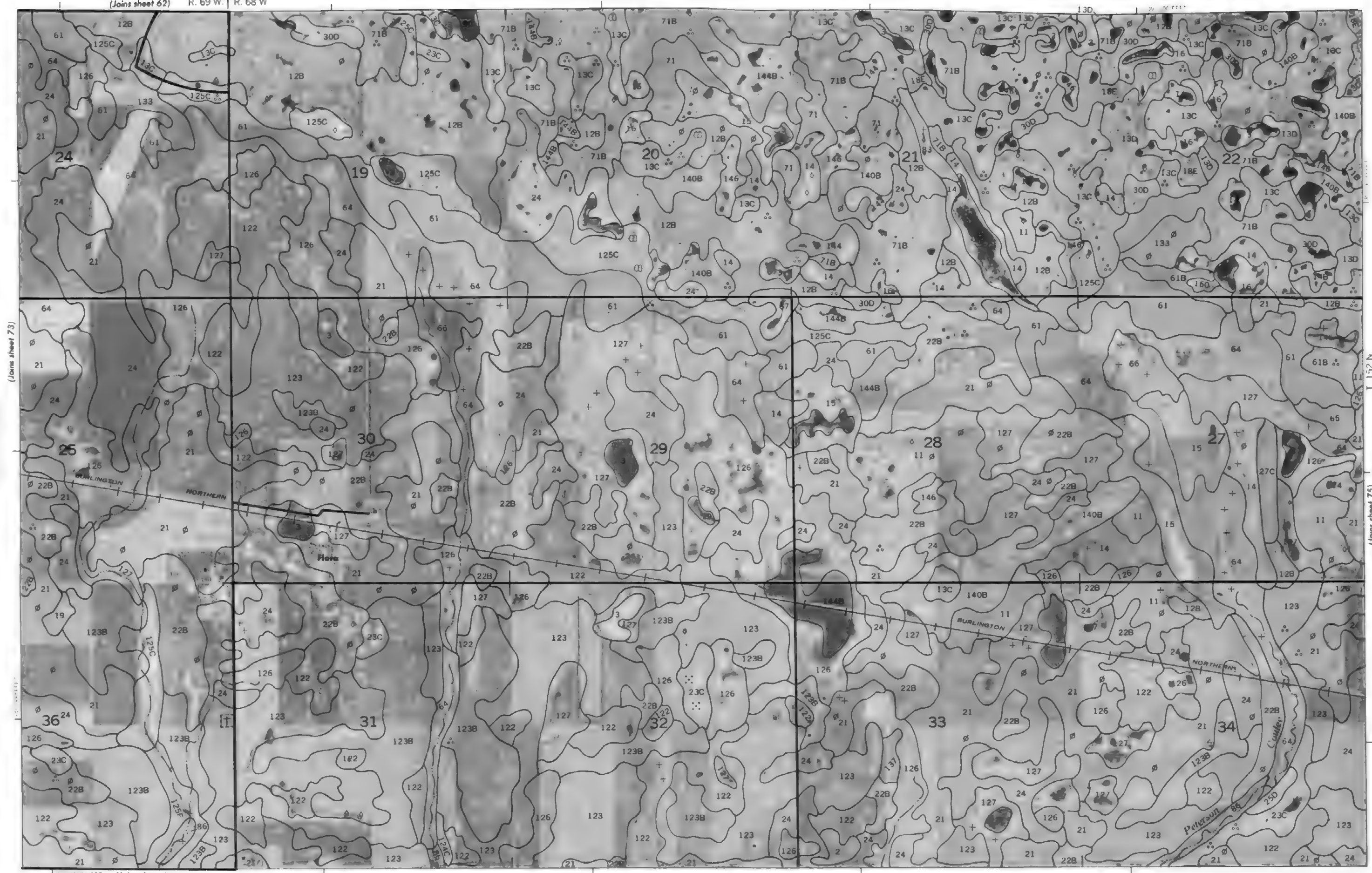
T. 152 N.

(Joins sheet 73)





(Joins sheet 62) R. 69 W. | R. 68 W



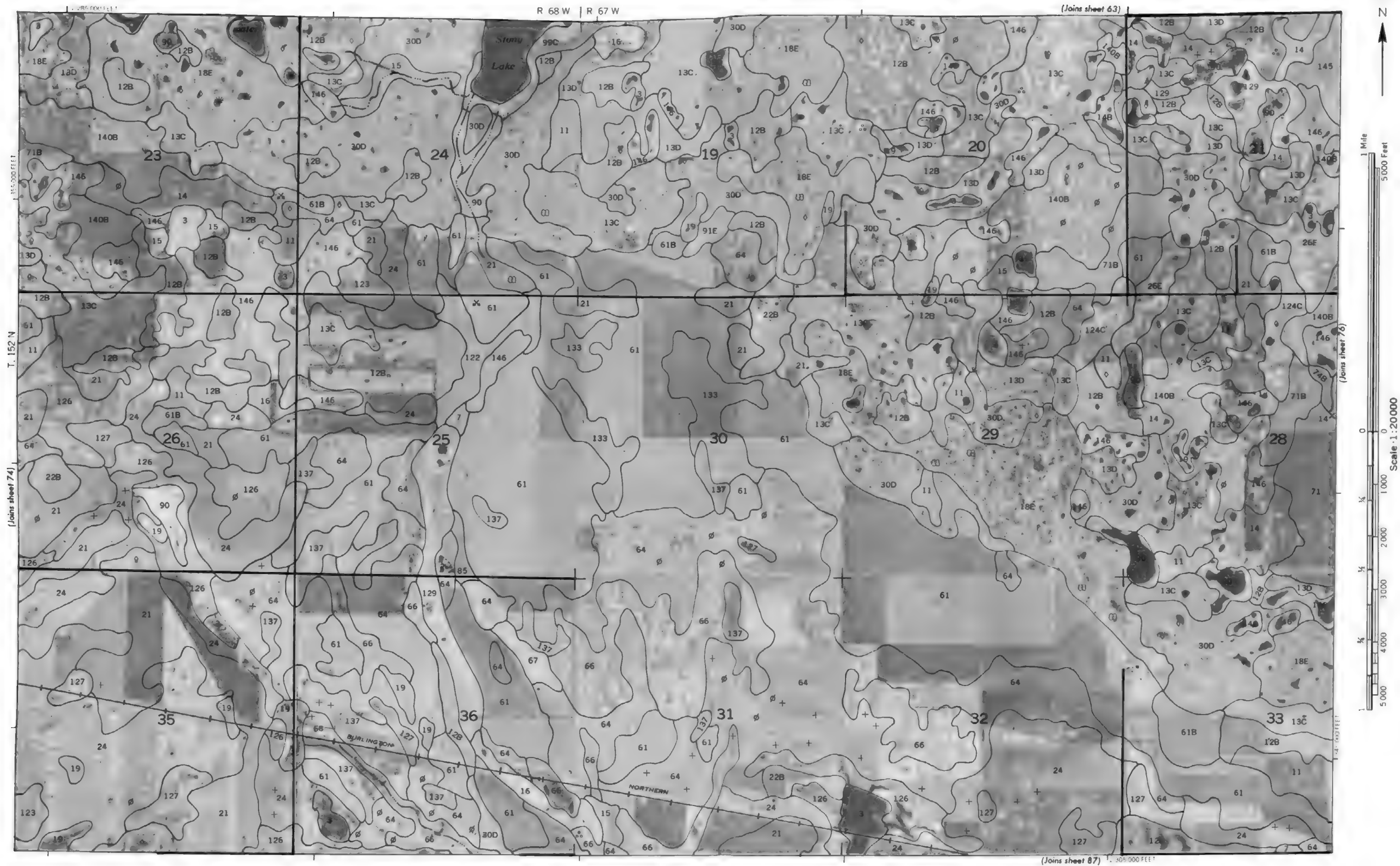
(Joins sheet 73)

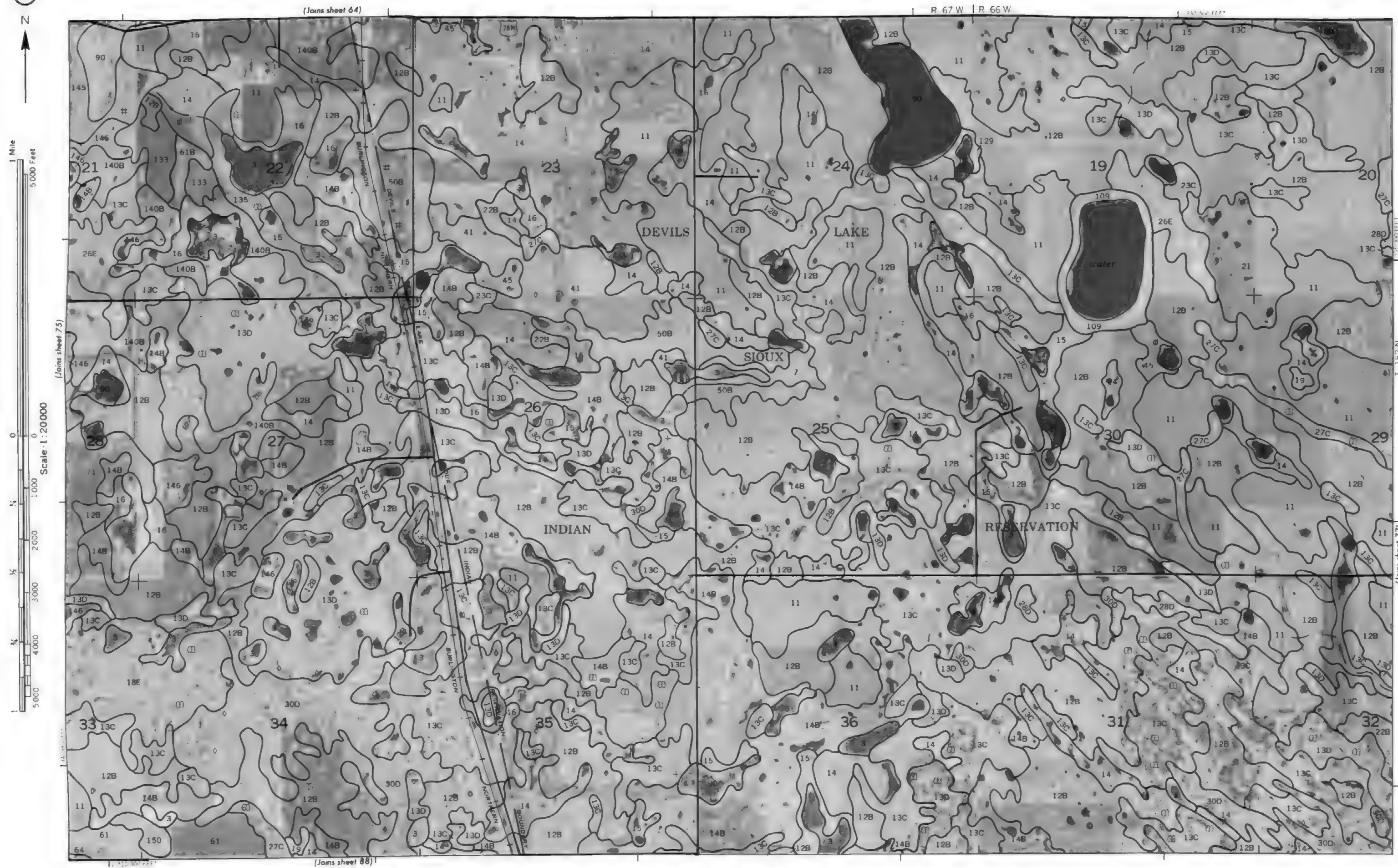
Scale 1:20000

T 152 N.

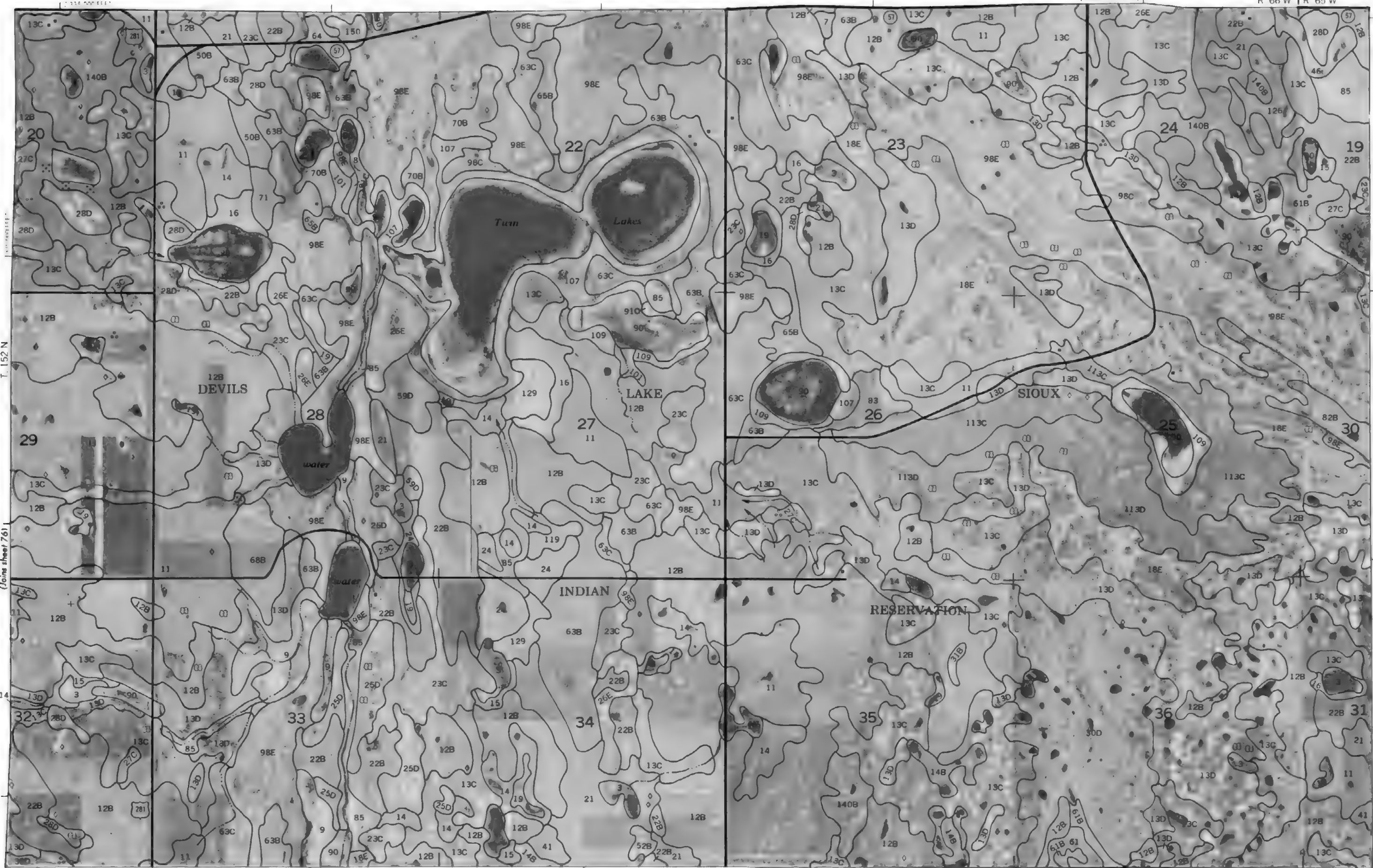
(Joins sheet 75)

(Joins sheet 86)





(Joins sheet 65) R 66 W | R 65 W





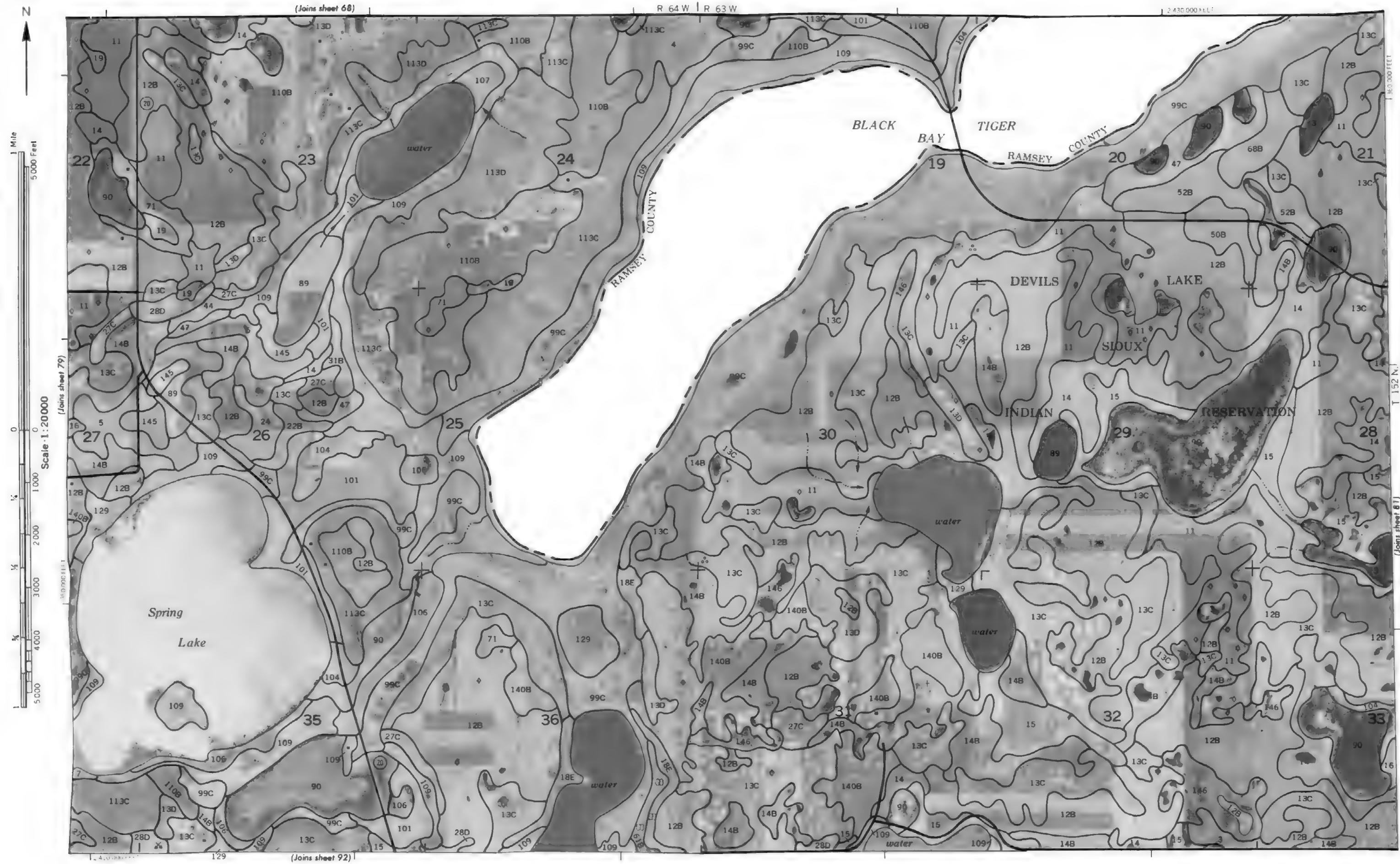
(Joins sheet 67)



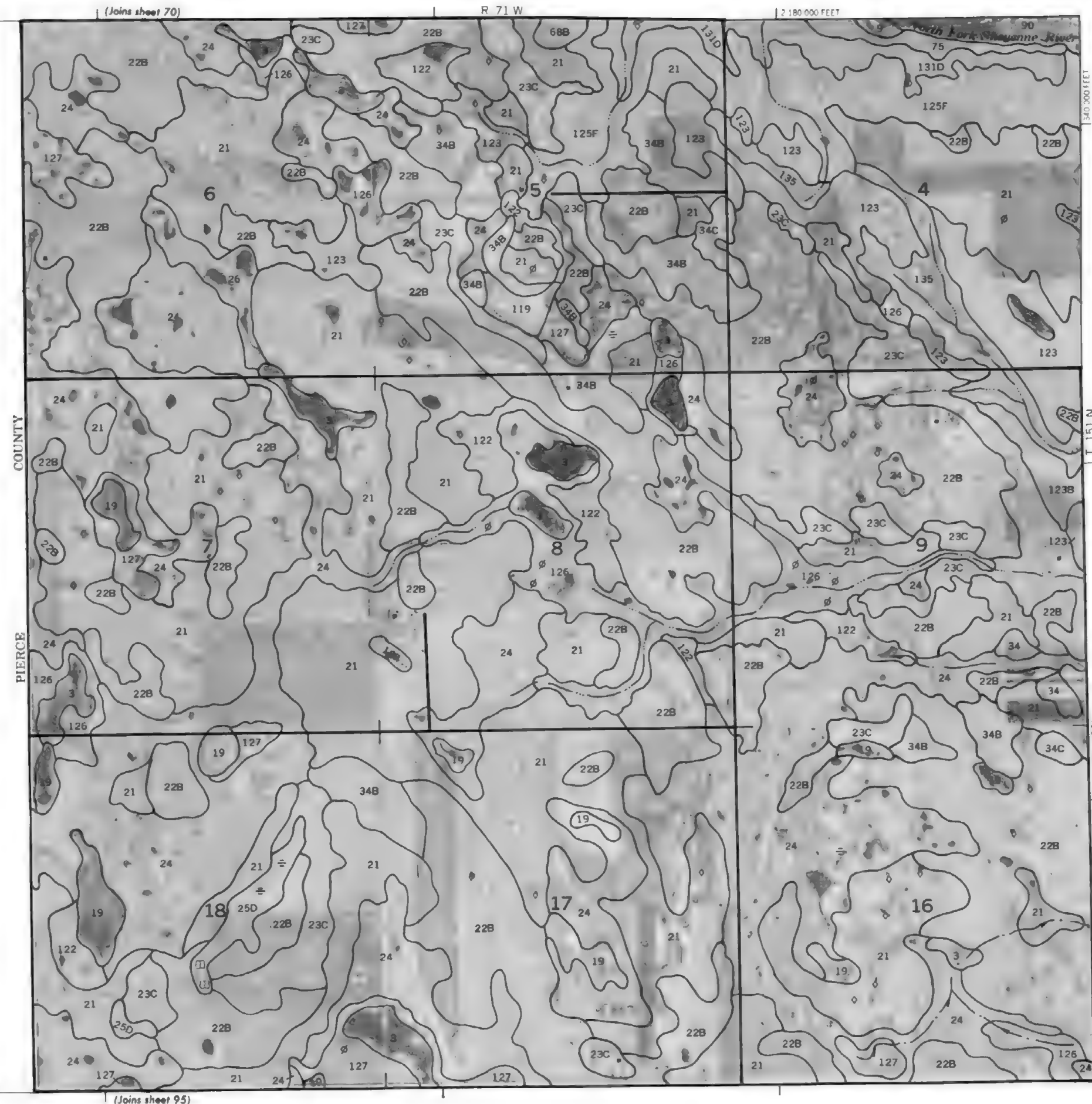
(Joins sheet 80) I

0
0000061700000

(Joins sheet 91)

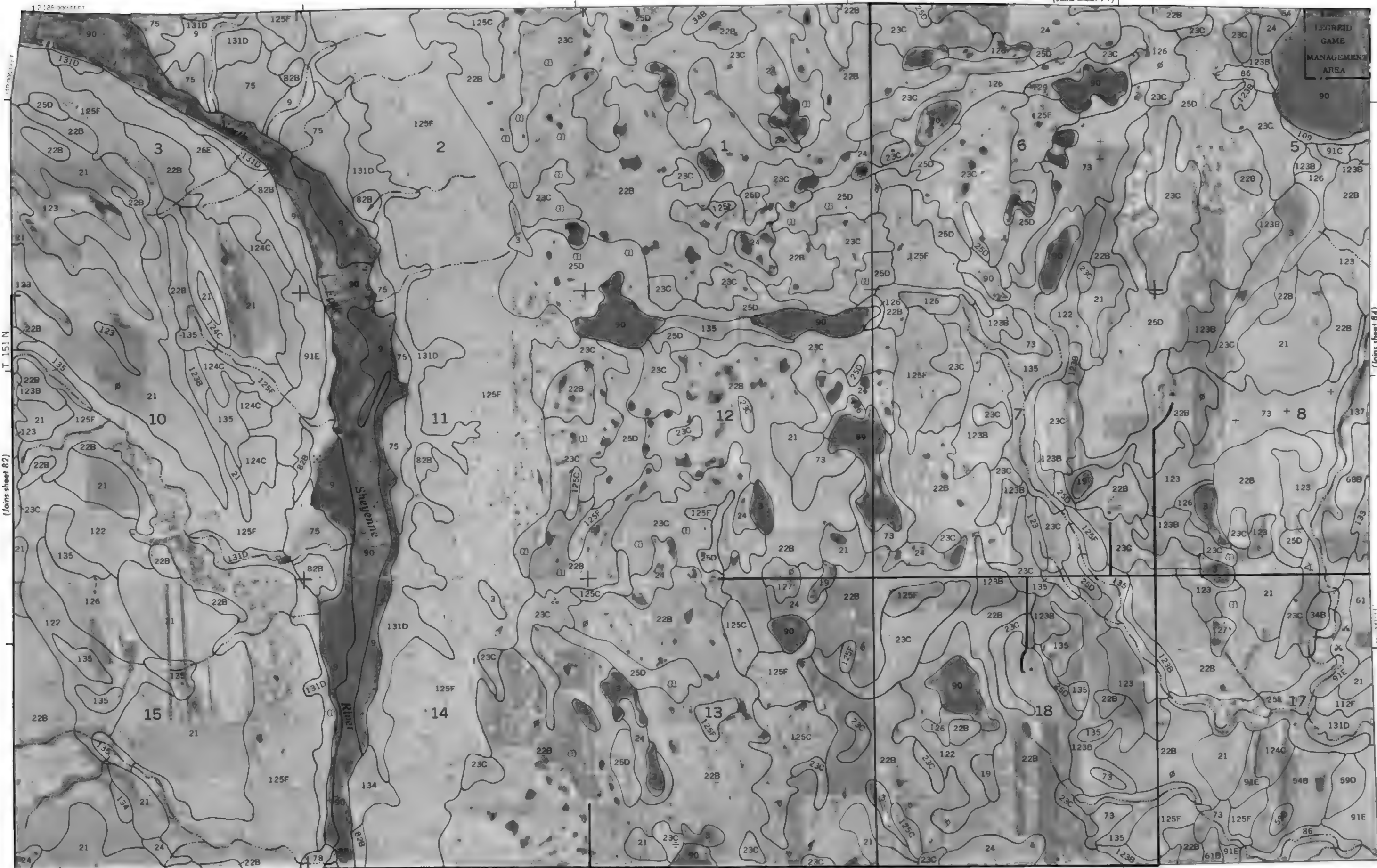






R 71 W | R. 70 W

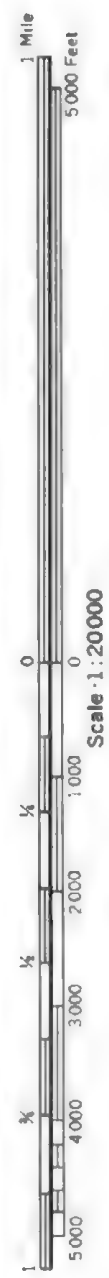
(Joins sheet 71)

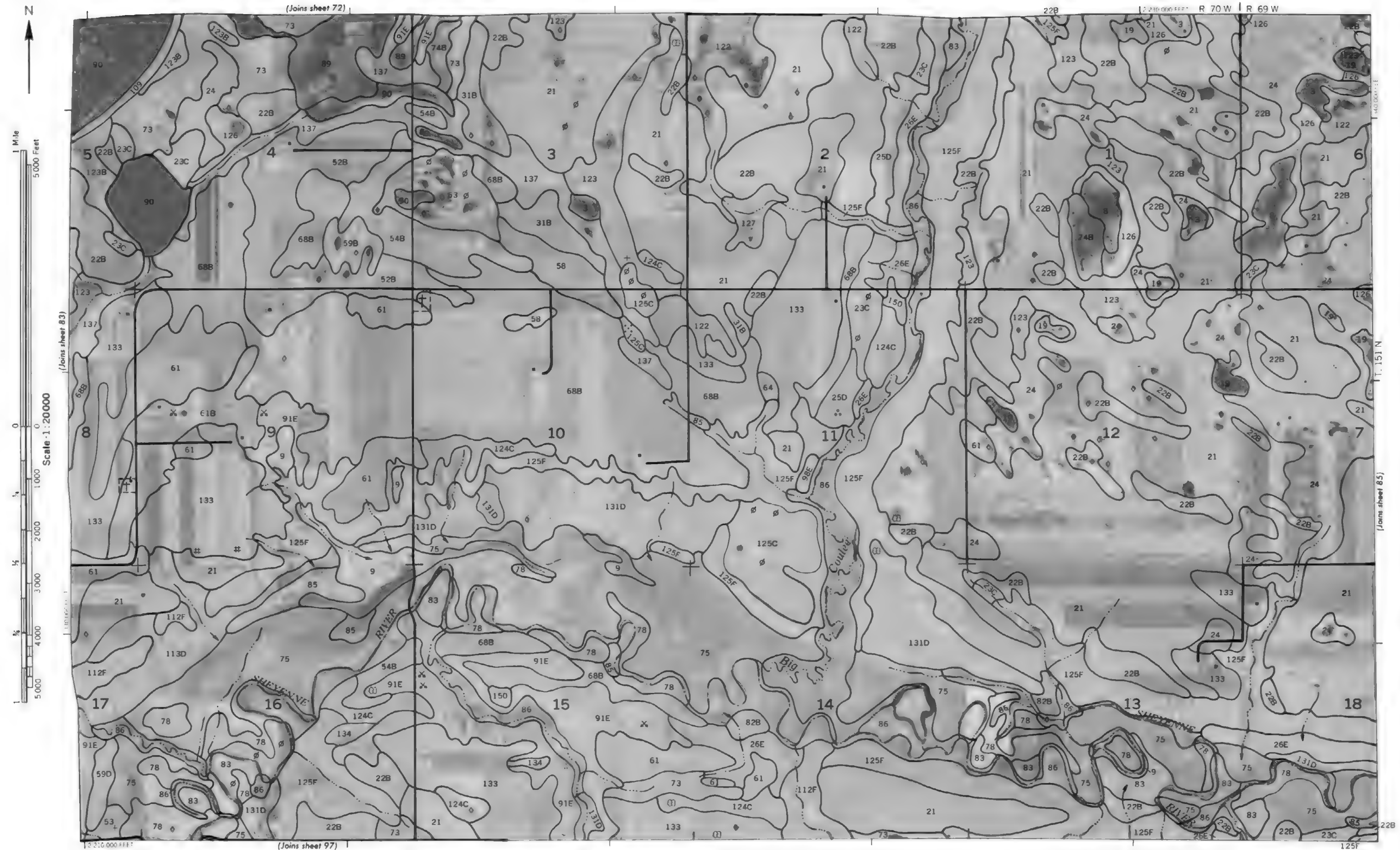


(Joins sheet 82)

(Joins sheet 84)

(Joins sheet 96)



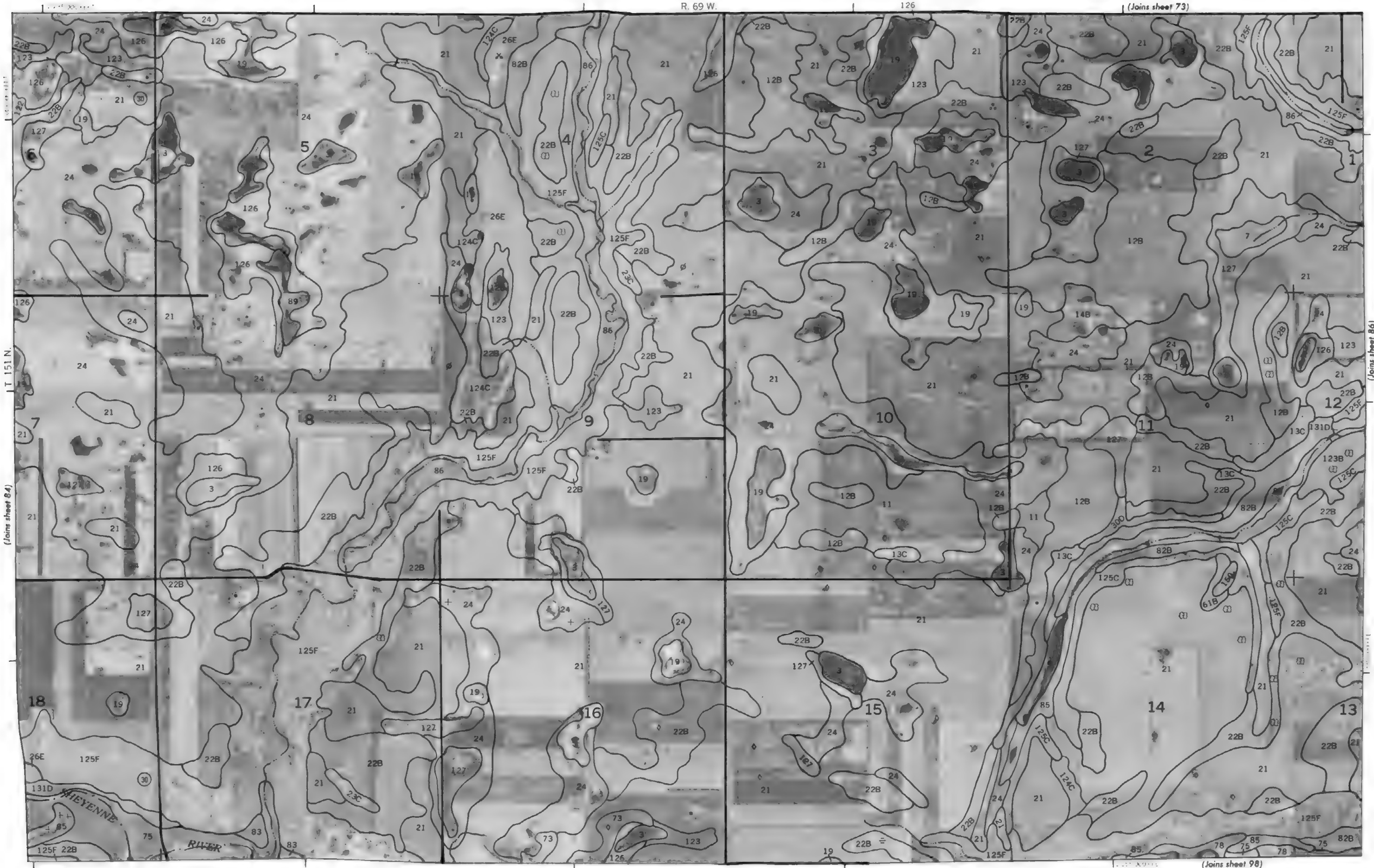




R. 69 W.

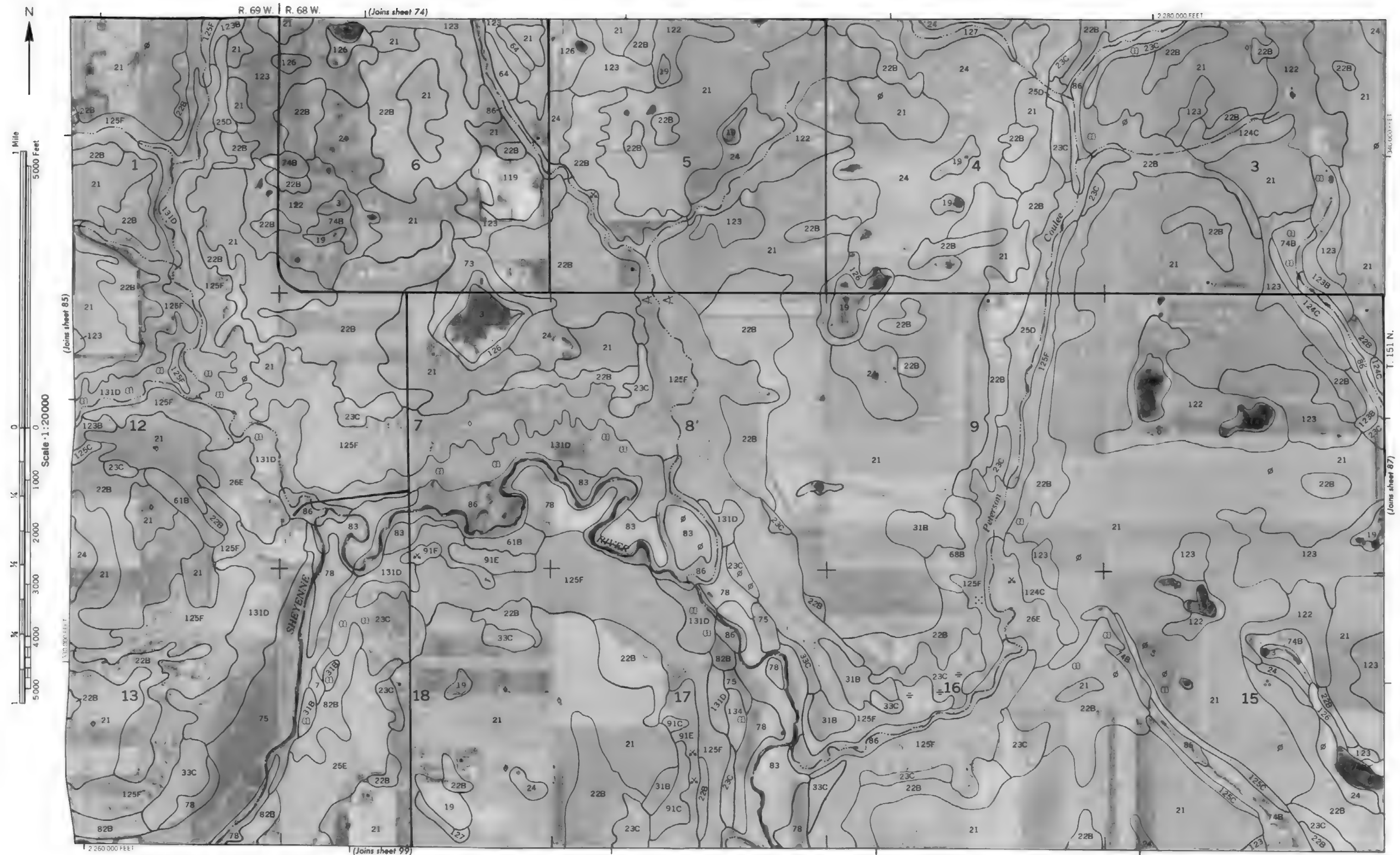
126

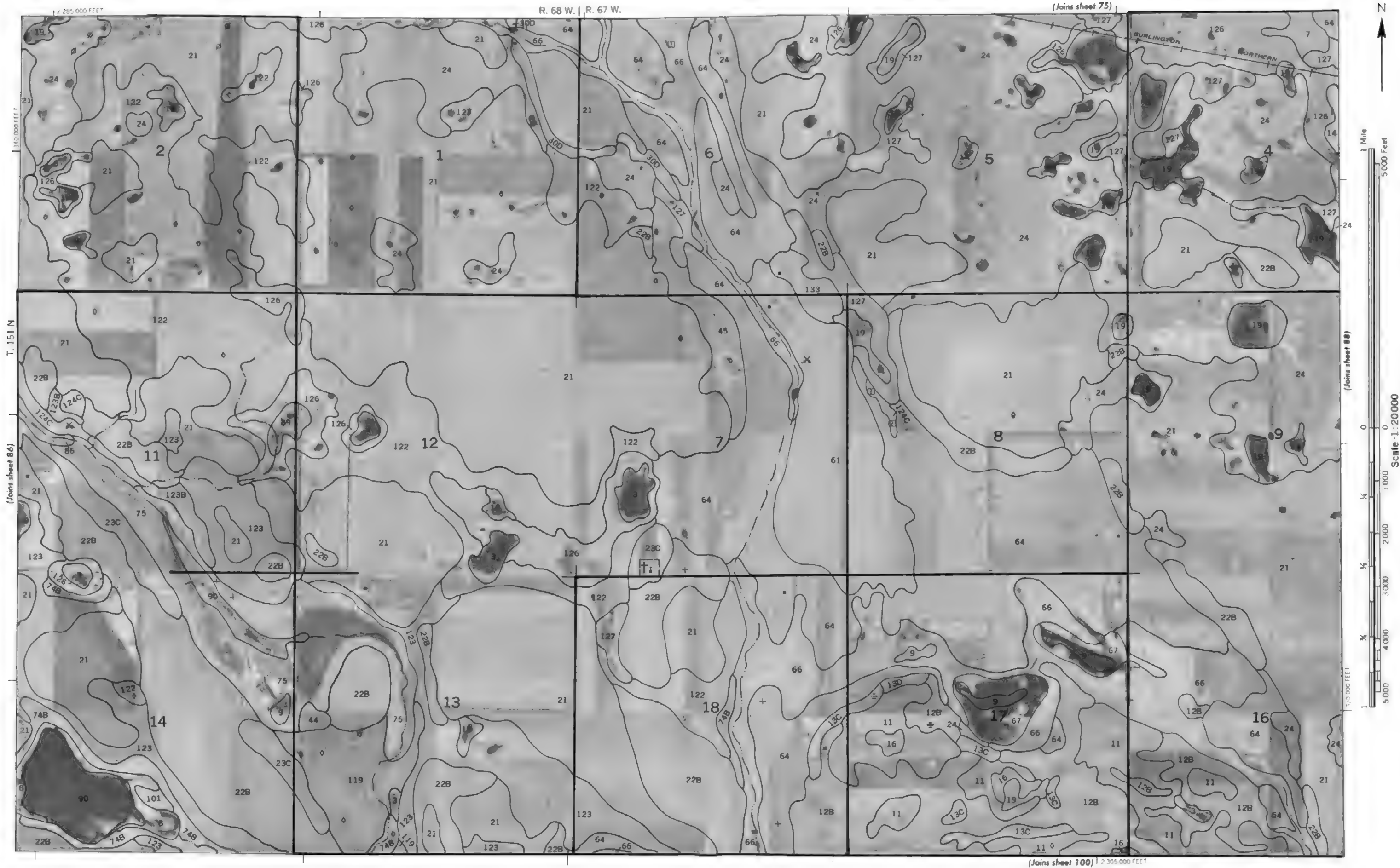
(Joins sheet 73)



(Joins sheet 86)

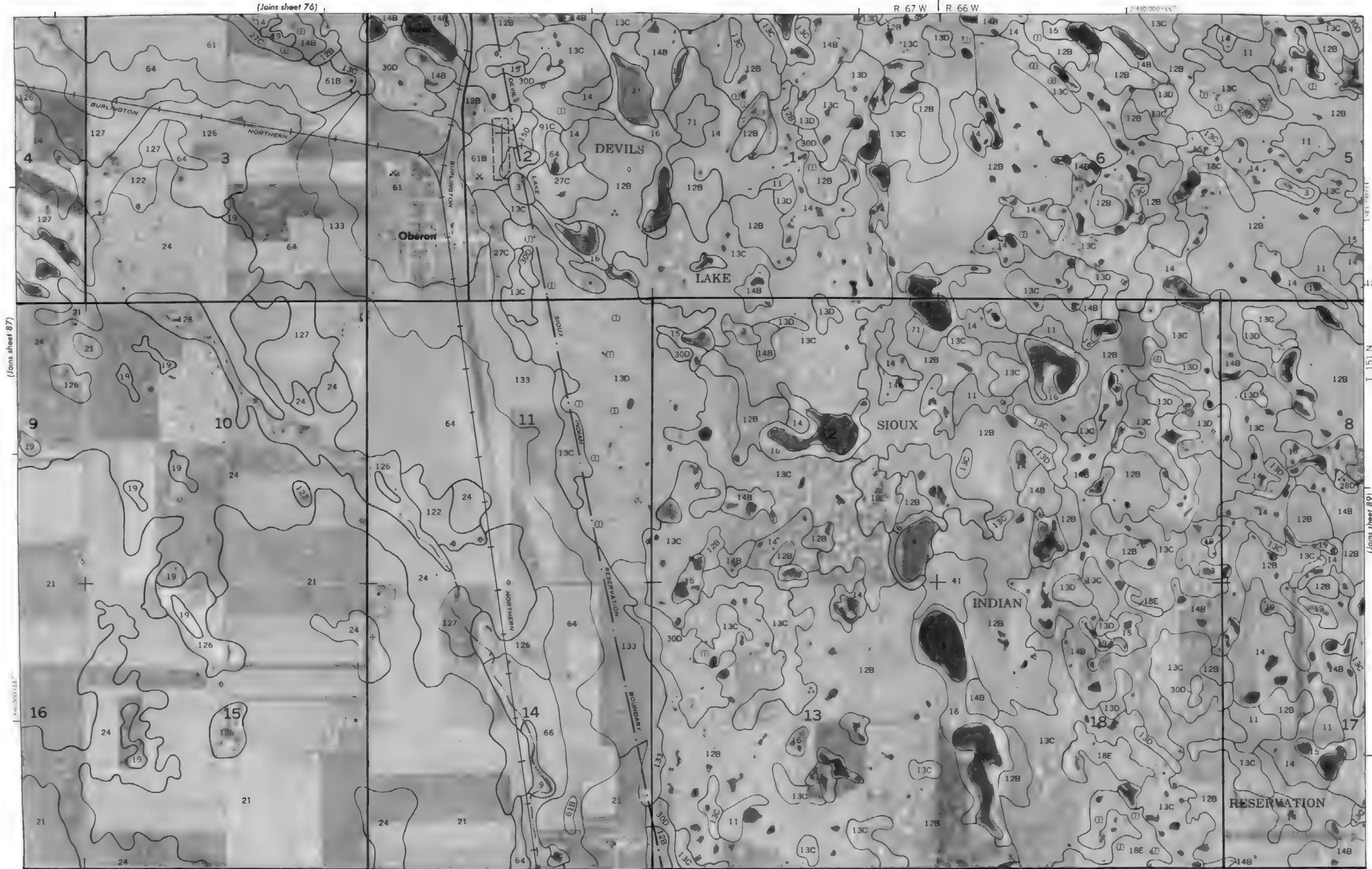
(Joins sheet 98)







Scale: 1:20000



(Joins sheet 76)

R 67 W | R 66 W

T 151 N

(Joins sheet 87)

(Joins sheet 89)

(Joins sheet 101)

(Joins sheet 77)

R. 66 W. | R. 65 W.



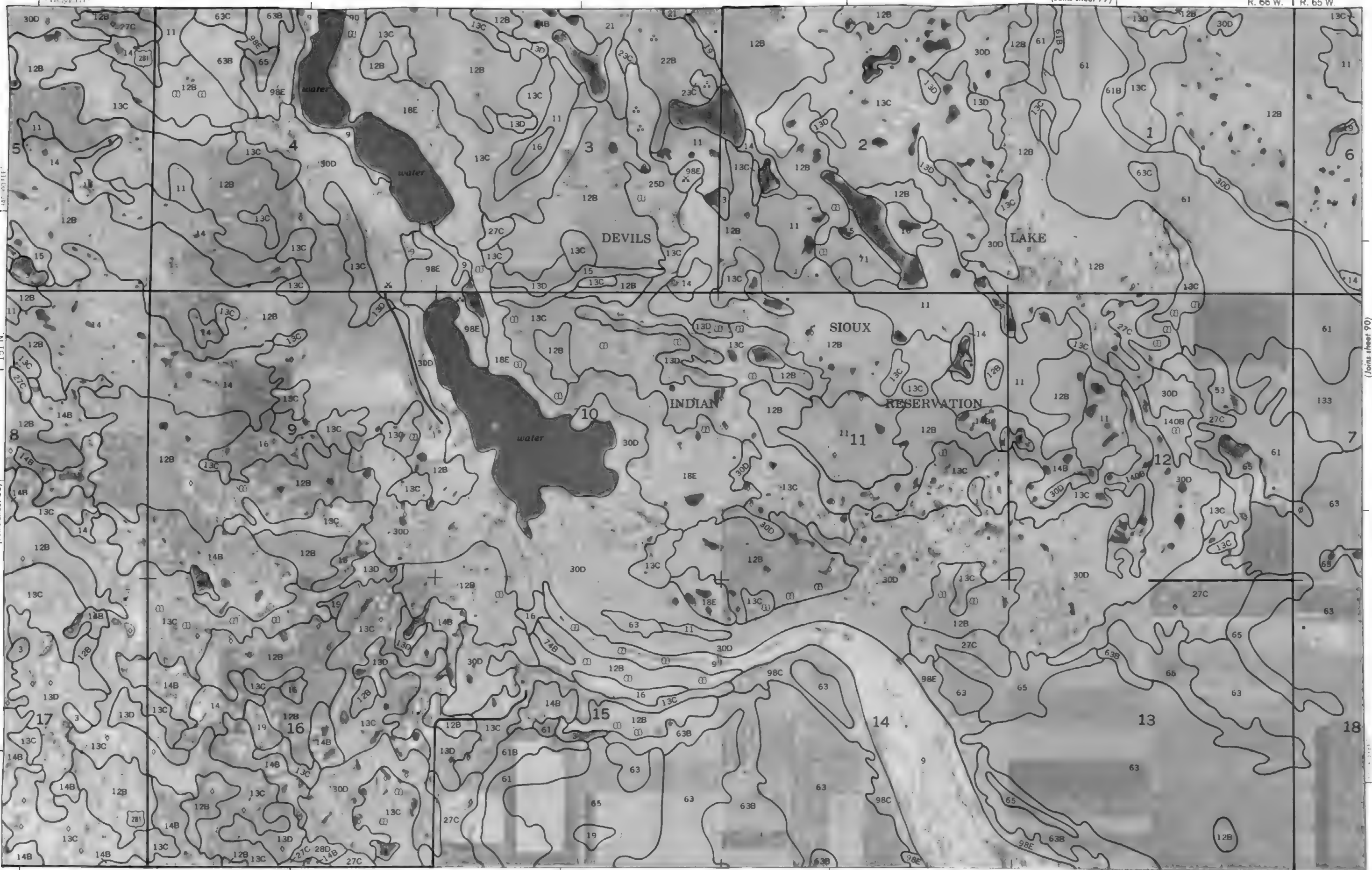
1 Mile
5000 Feet

Scale 1:20000

(Joins sheet 90)



(Joins sheet 102)



T. 151 N.

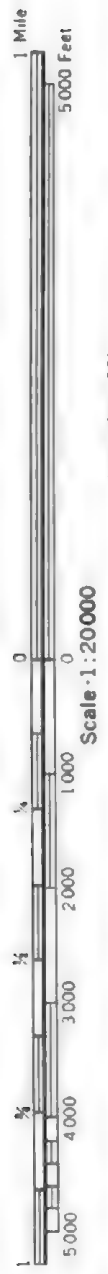
(Joins sheet 88)



(Joins sheet 78)

R 65 W

1:380 000 FEET



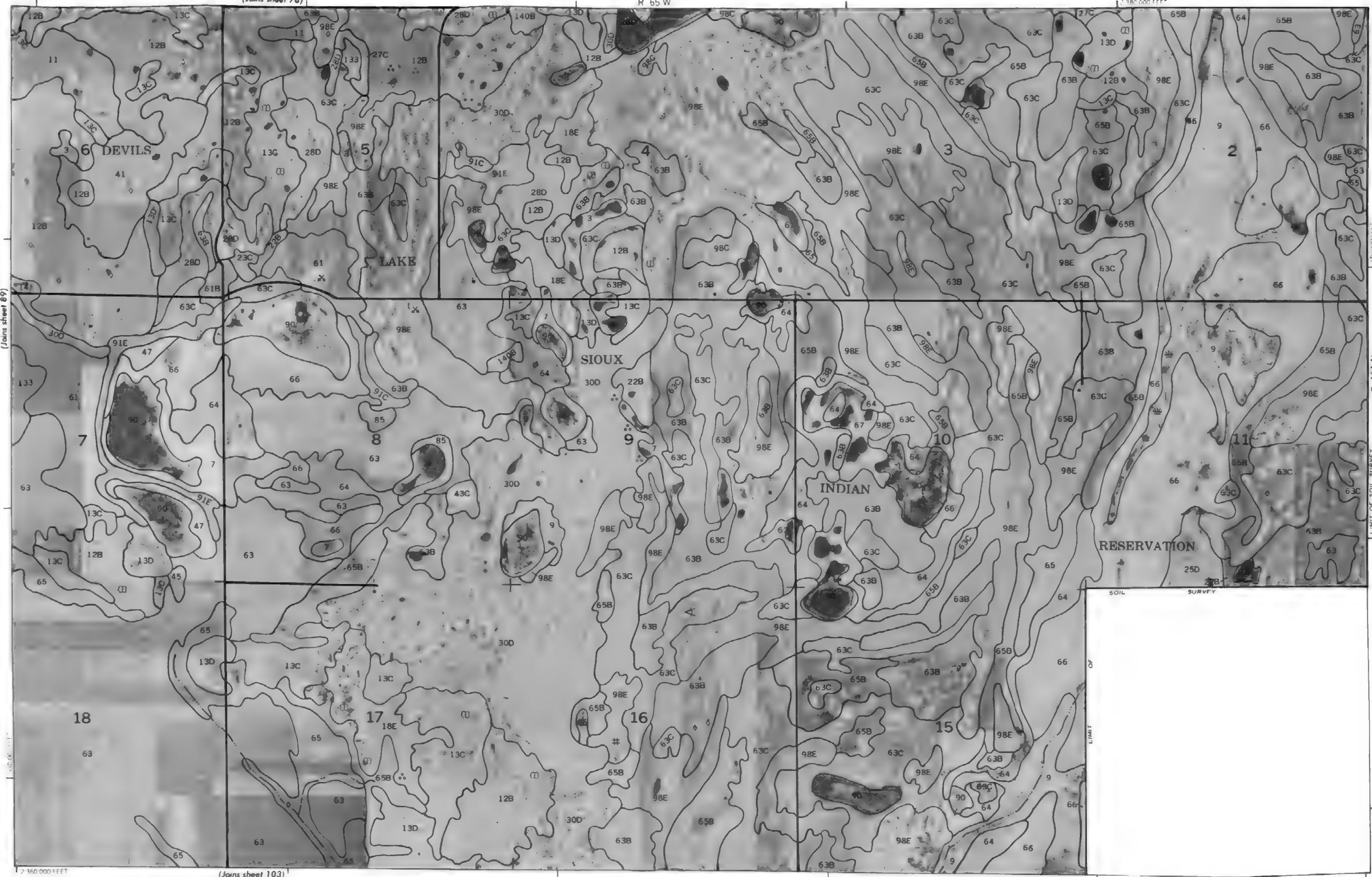
(Joins sheet 89)

Scale 1:20000

Scale 1:20000

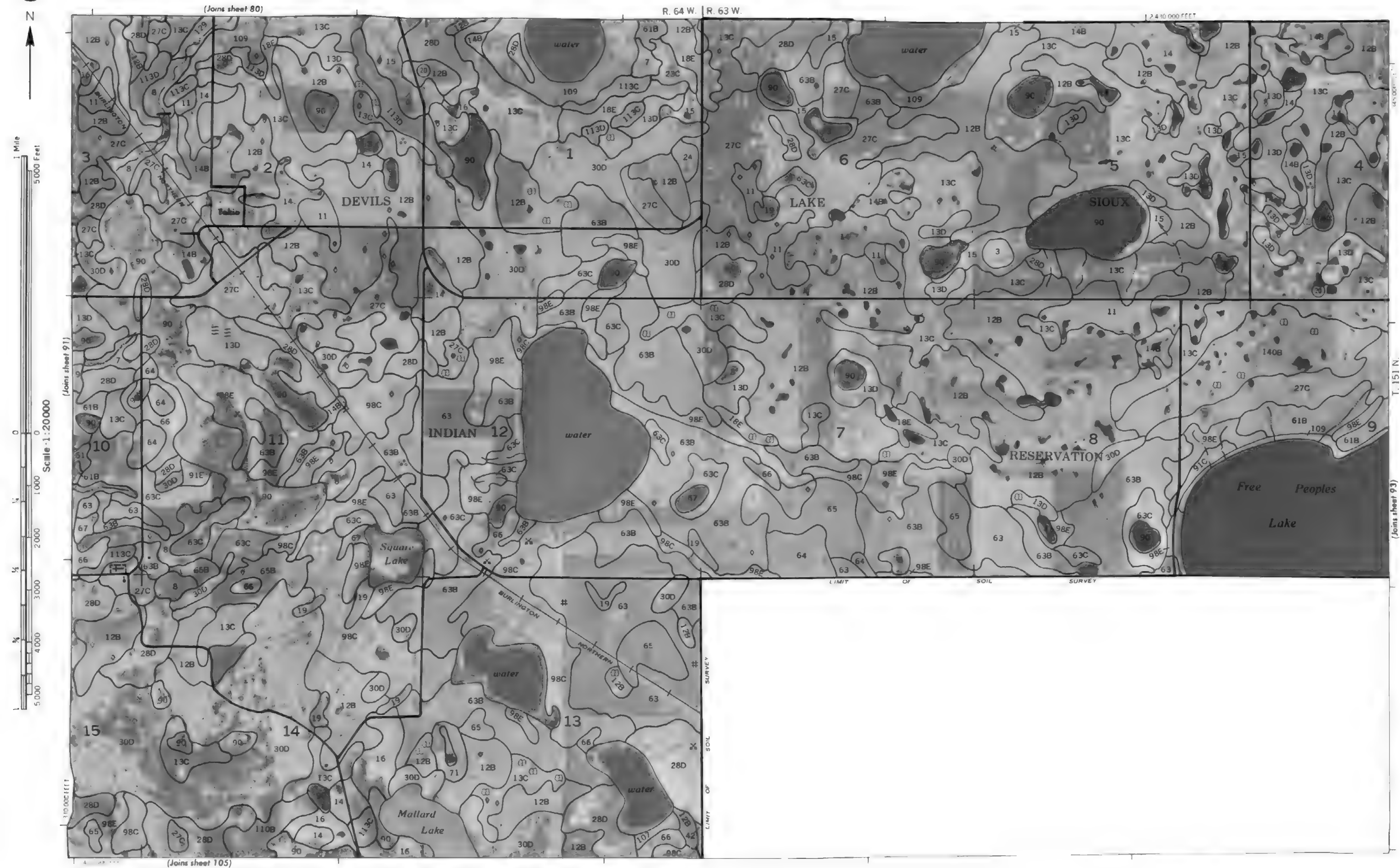
1:360 000 FEET

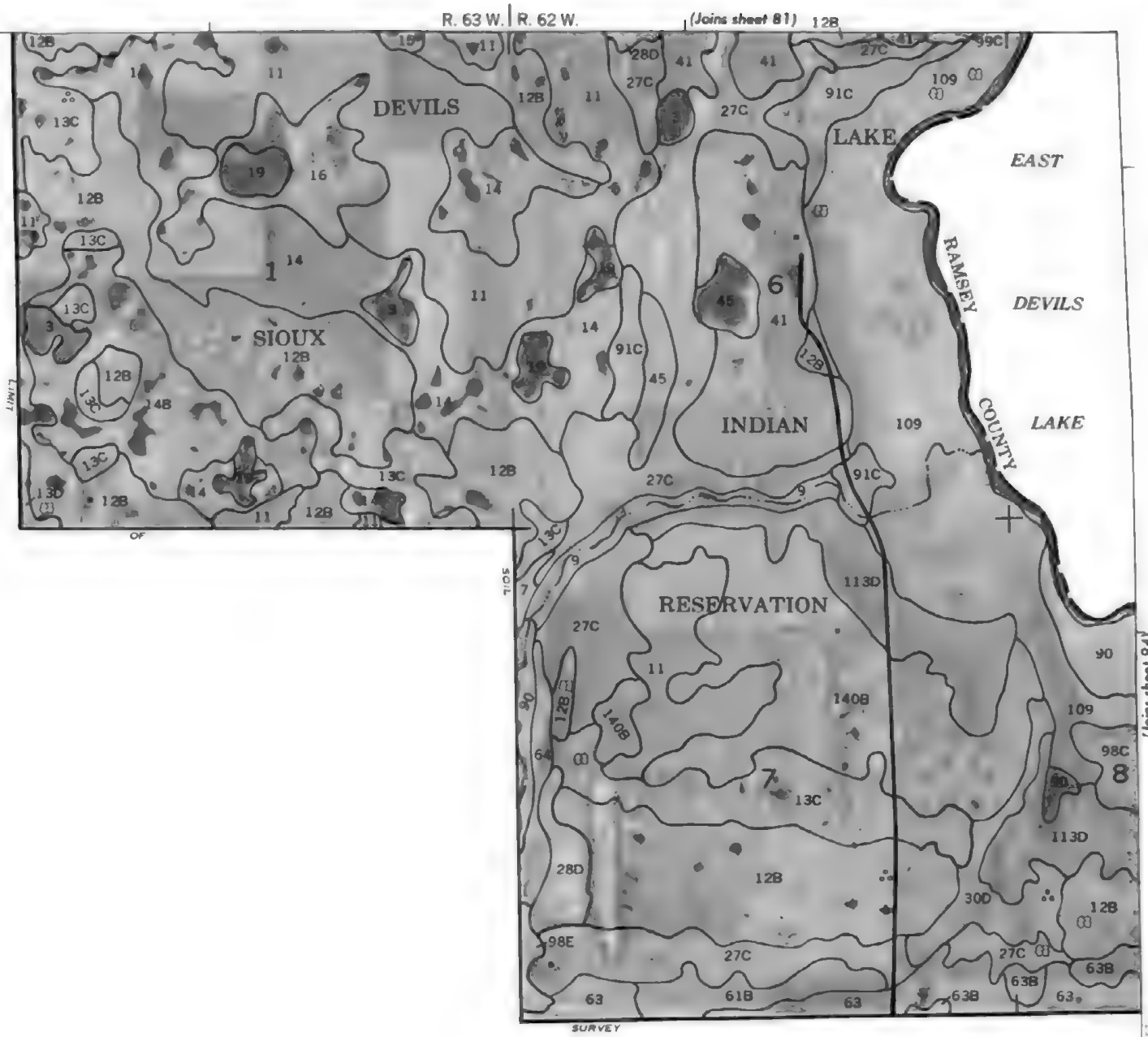
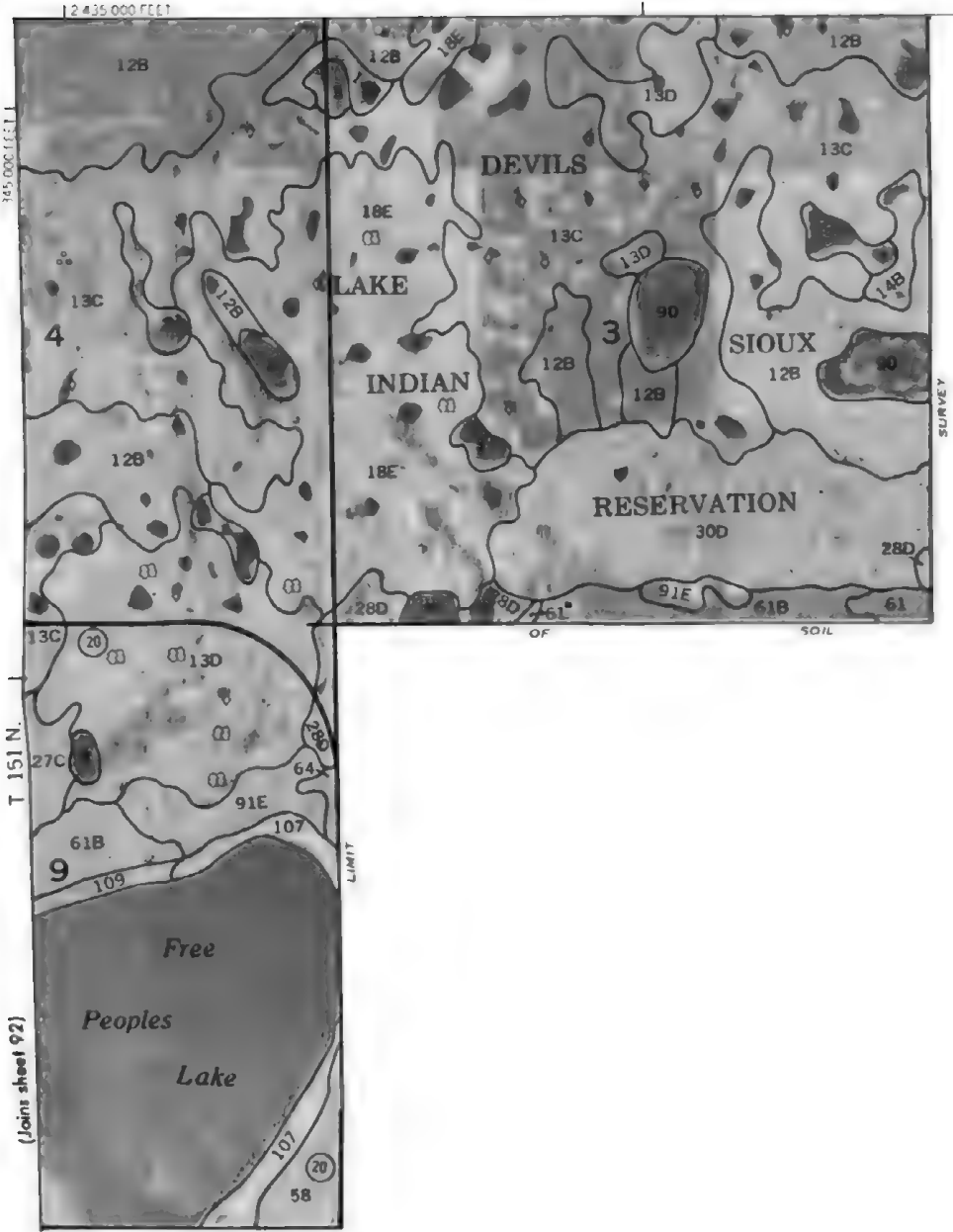
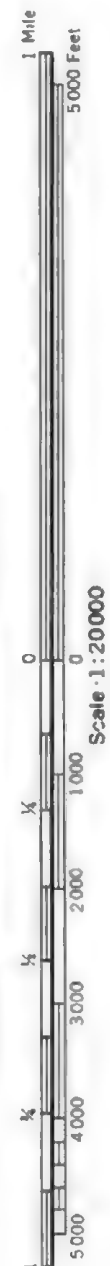
(Joins sheet 103)



T. 151 N.
LIMIT OF SOIL SURVEY









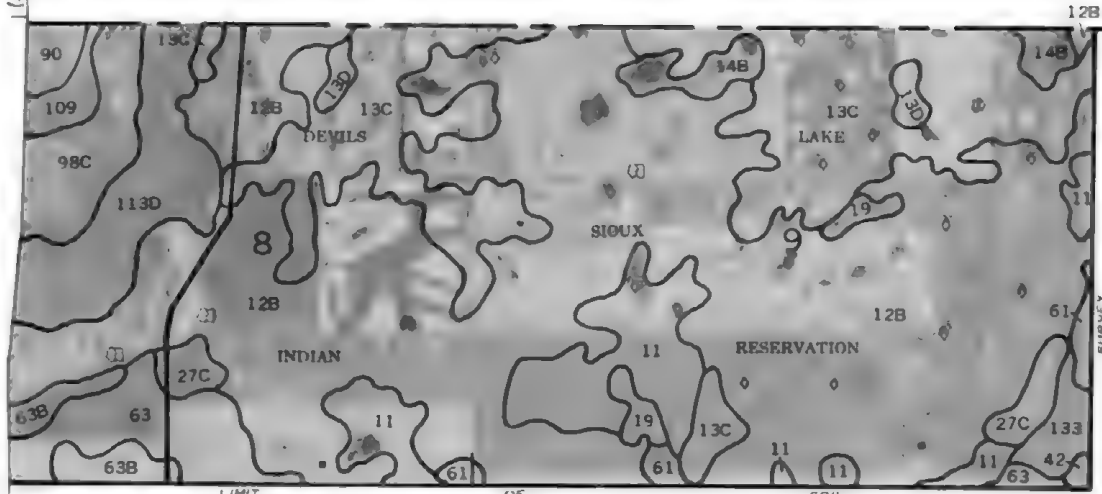
R. 62 W.

2 480 000 FEET

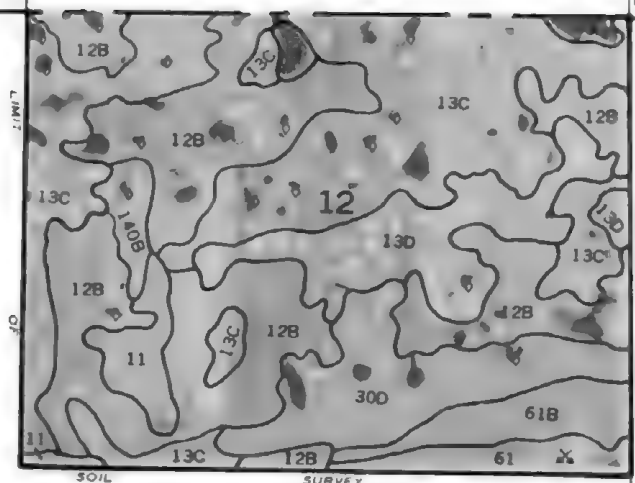
345 000 FEET

(Join sheet 93)

Scale 1:20000



RAMSEY COUNTY



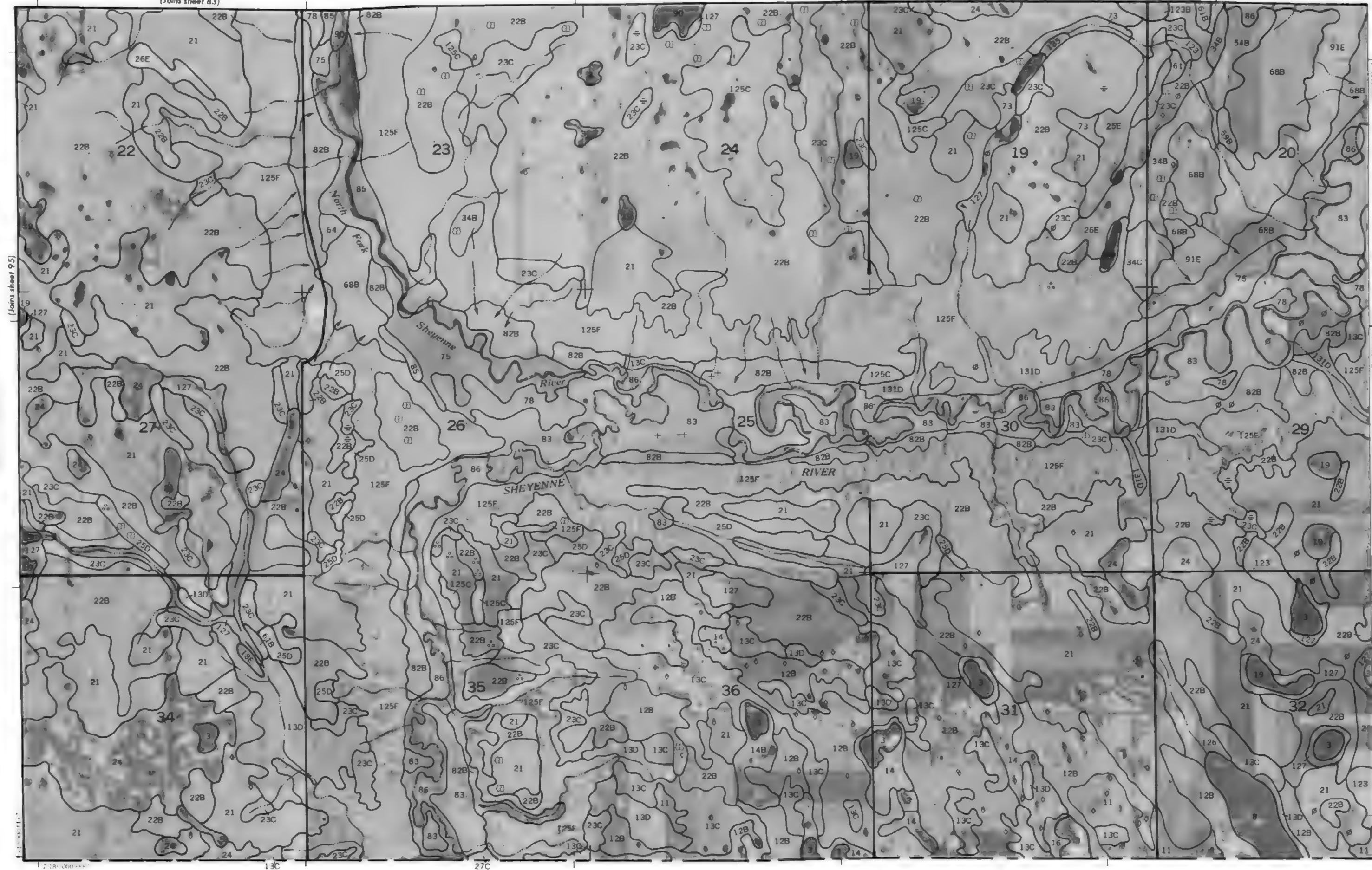
T. 151 N.

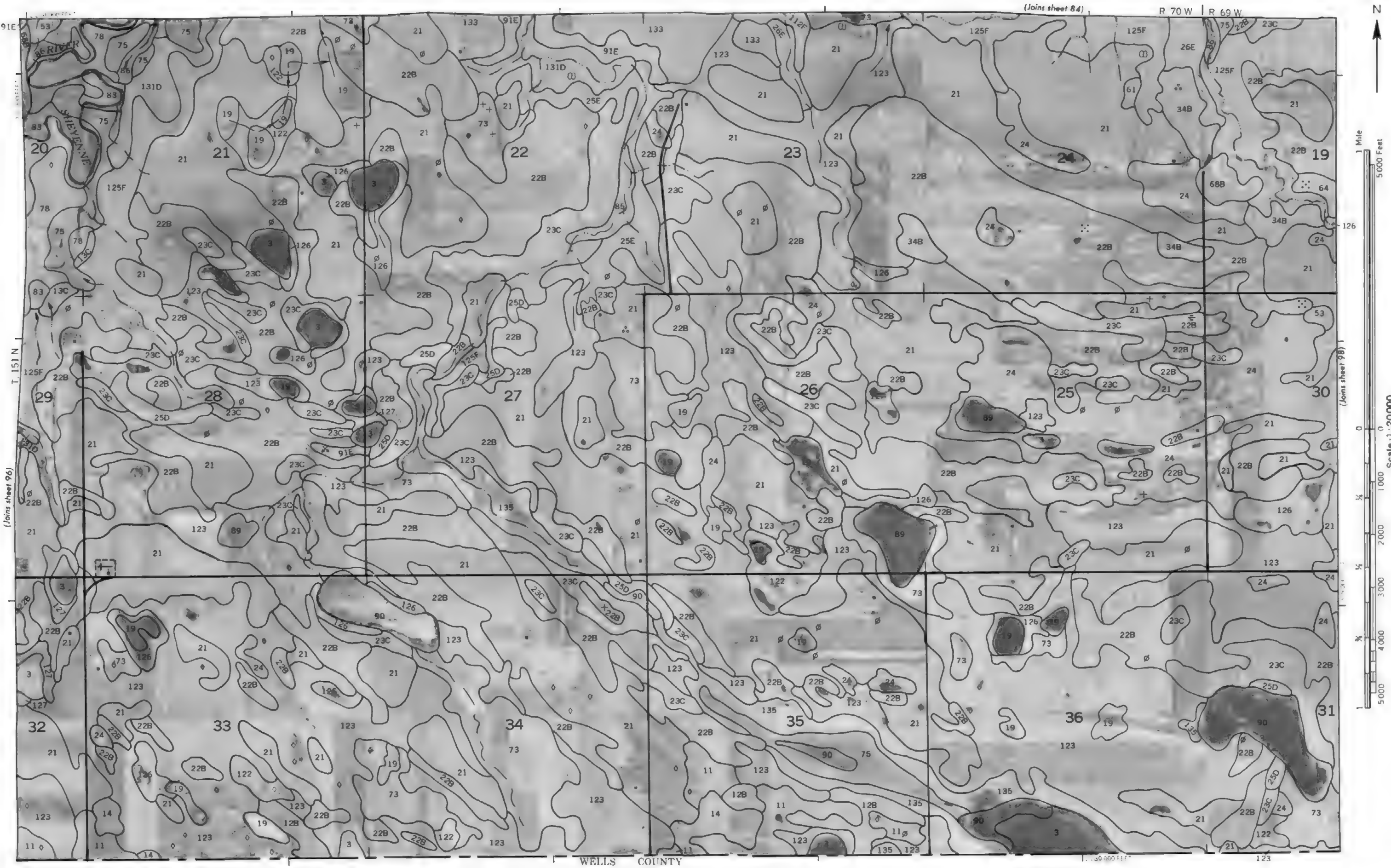
NELSON COUNTY

2 465 000 FEET



(Joins sheet 83)





(Joins sheet 85)

R 69 W

7.



1 Mile
5,000 Feet

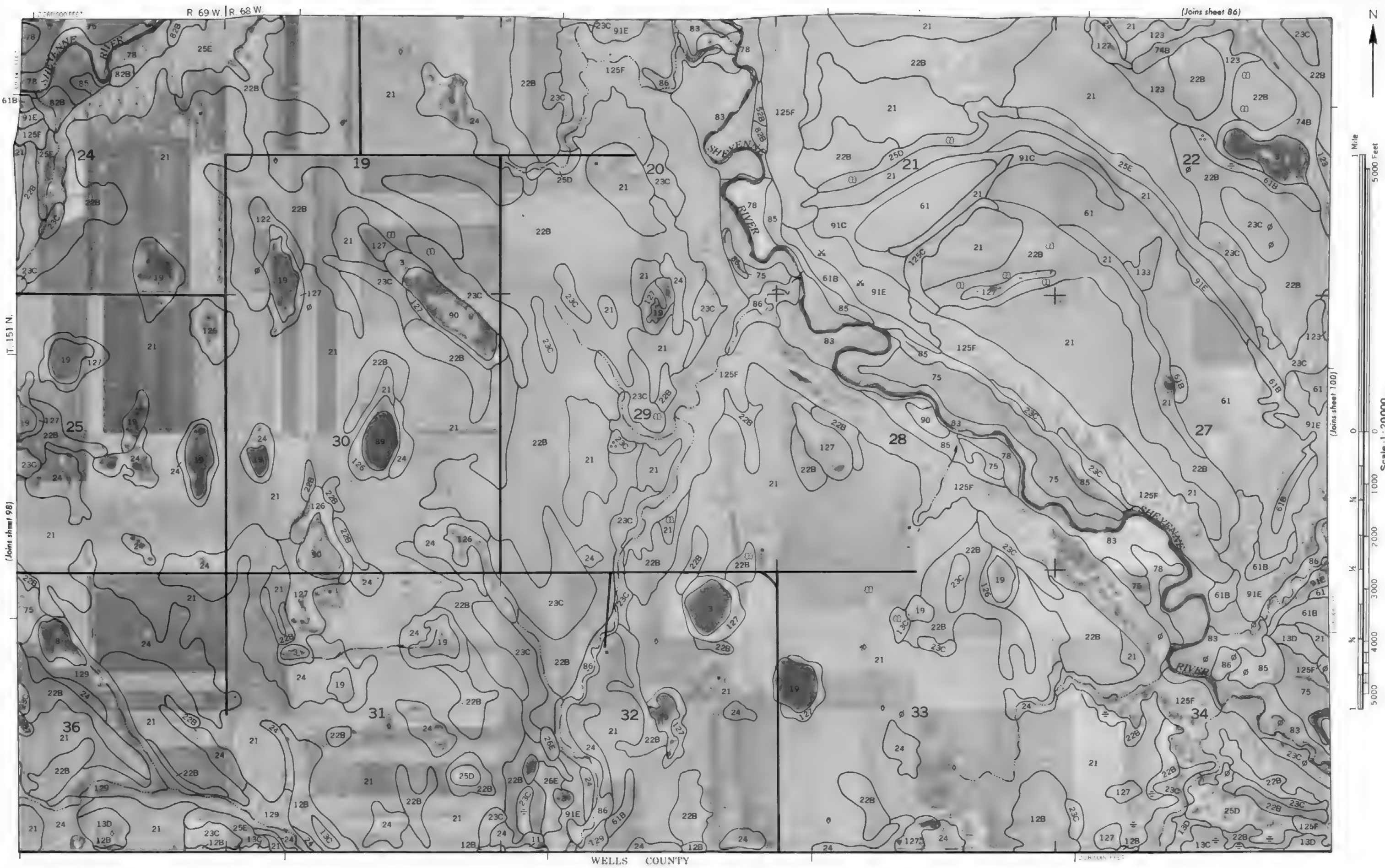
Scale: 1:20000

Join us! (261 971)

161 A

Country	1980	1985	1990	1995	2000
Japan	18.5	19.5	20.5	21.5	22.5
France	15.5	16.5	17.5	18.5	19.5
Germany	14.5	15.5	16.5	17.5	18.5
Italy	13.5	14.5	15.5	16.5	17.5
Spain	12.5	13.5	14.5	15.5	16.5
United Kingdom	11.5	12.5	13.5	14.5	15.5
Sweden	10.5	11.5	12.5	13.5	14.5
United States	9.5	10.5	11.5	12.5	13.5

WELLS COUNTY



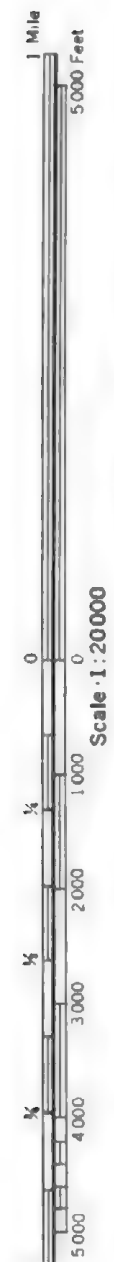


(Join sheet 87)

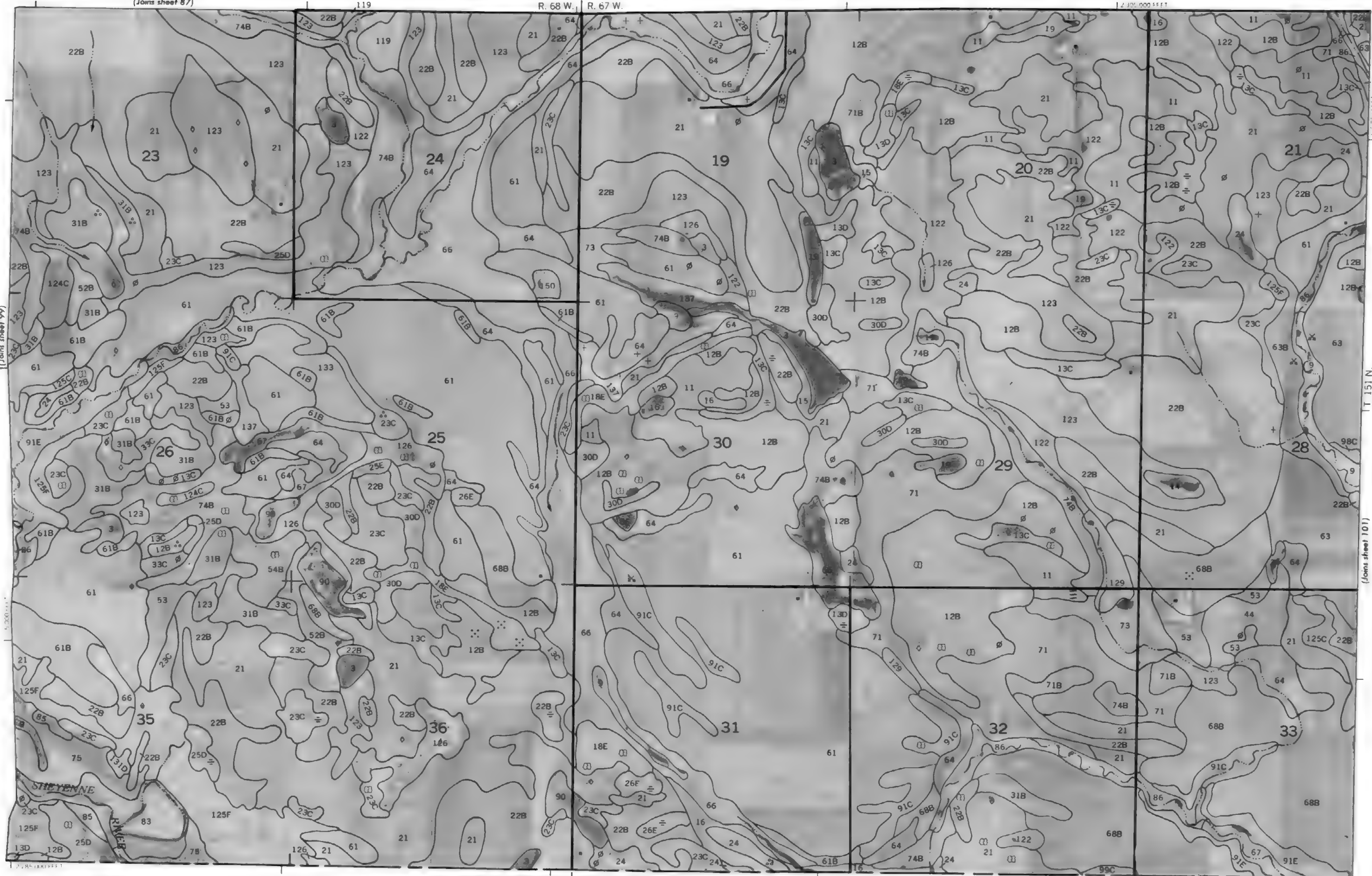
119

R. 68 W. | R. 67 W.

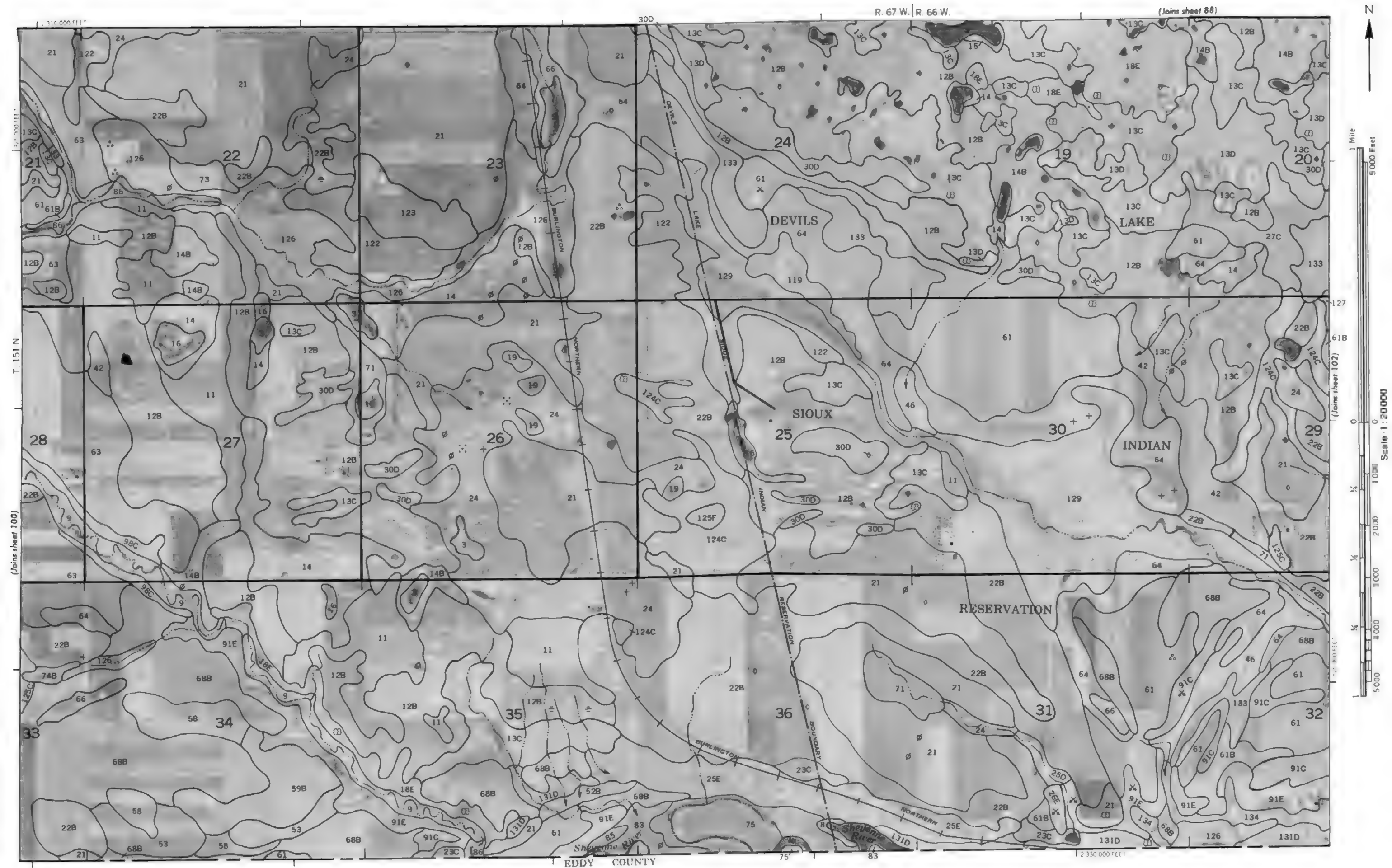
12 300 000 Feet



Scale 1:20000



WELLS COUNTY | EDDY COUNTY





(Joins sheet 89)

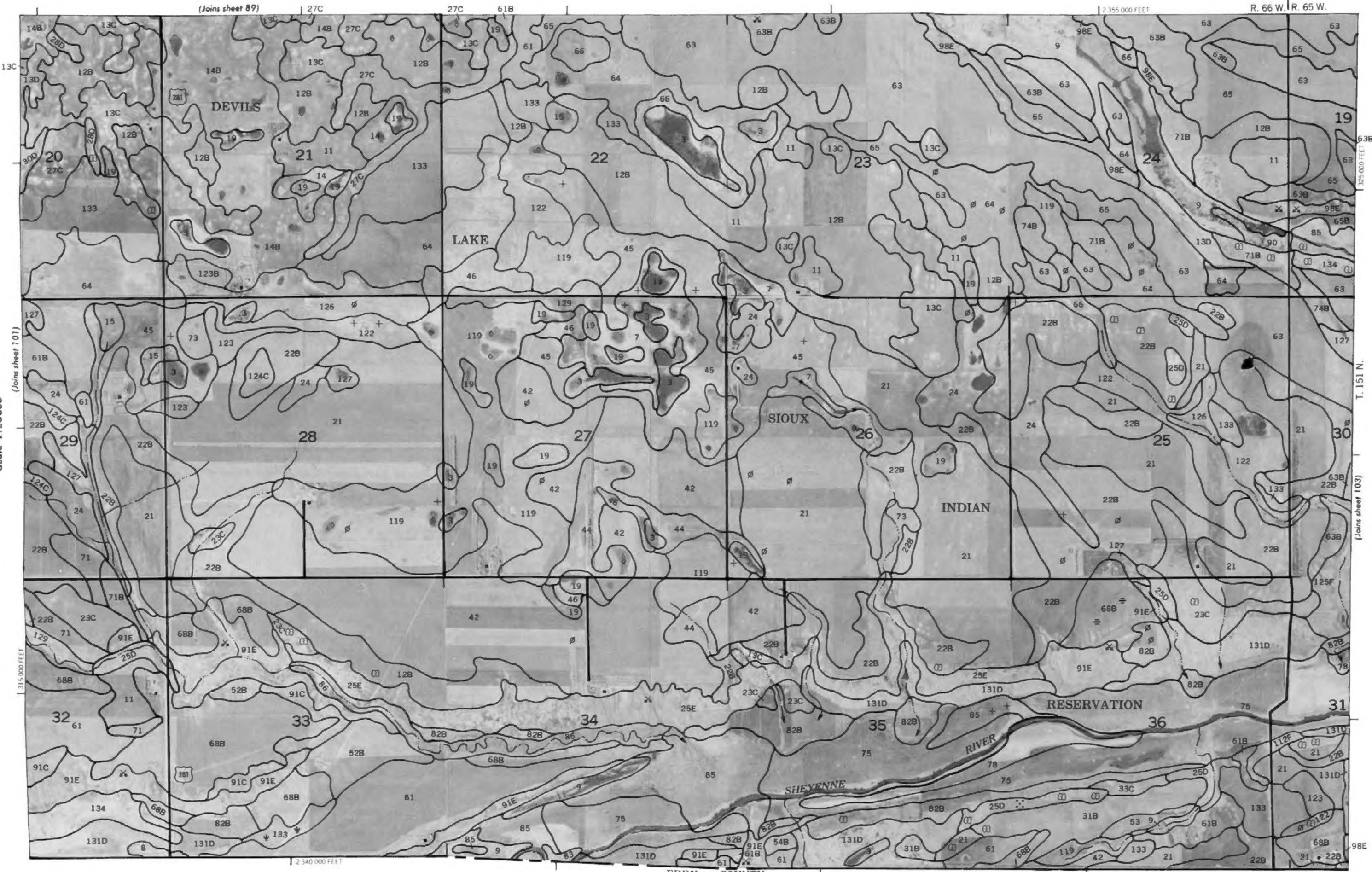
27C

27C

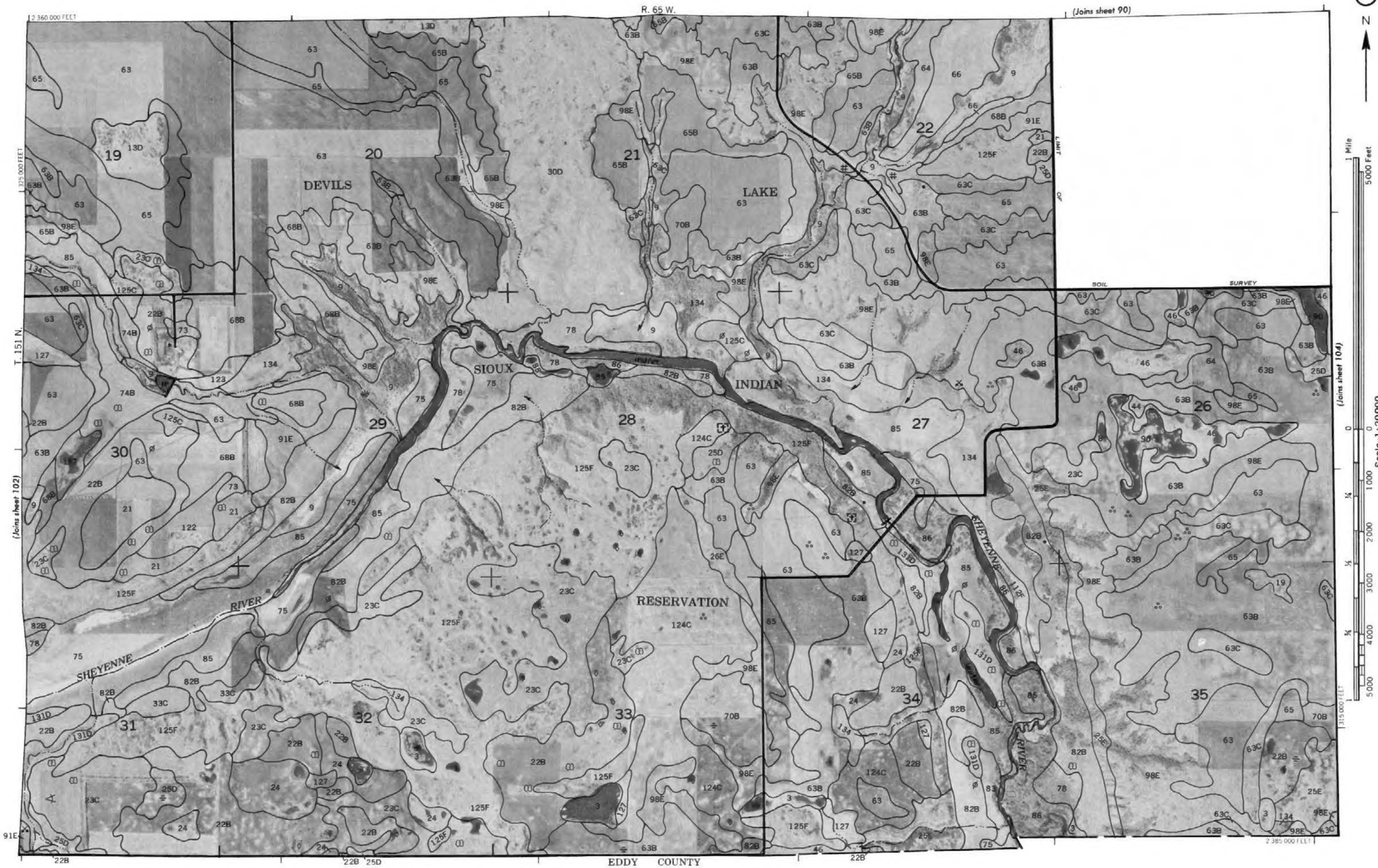
61B

2 355 000 FEET

R. 66 W. | R. 65 W.



EDDY COUNTY



R. 65 W. | R. 64 W.

